The New Zealand

Journal of Agriculture.

VOL. 50. WELLINGTON, 20TH MAY, 1935. No. 5.

POTATO-GROWING IN NEW ZEALAND.

PART I.—ADVICE TO GROWERS IN REGARD TO THE MAINTENANCE OF PURE AND HEALTHY SEED-STOCKS.

R. THOMSON, Assistant in Agronomy, Government Pure Seed Station, Lincoln.

MOST growers recognize the necessity of using "good seed," but very few of them could define at all correctly what are the essentials of seed that might be termed good nor the factors that render seed unproductive. The purpose of this article is to discuss these matters from the point of view of the grower, to guide him in the purchase of seed, and to help him to maintain his seed-stocks in a pure and healthy condition.

If seed of one variety is collected from many different growers and all the seed is grown at one centre where each line has an equal chance of development, it will be found that some lines far outyield others. This variation of what might be termed "cropping-power" cannot be detected by an inspection of the seed-tubers, but necessitates an inspection of the crop in the field.

All growers aim at heavy yields, and in this objective the most important factor is the use of productive seed. The initial outlay in the purchase of such seed may be slightly greater, but rent and cultivation charges are the same, and it costs more per ton to dig a light crop than one that is heavier.

Preliminary investigations undertaken at the Ashburton Experiment Farm in the season 1927–28 revealed the fact that commercial stocks of seed were badly mixed, often wrongly named, and in many cases unproductive. It was found, moreover, that those who were dissatisfied with their crops—that is, those who had the least productive lines of seed—sold these and bought others, but bought with no assurance that they were not receiving some other grower's discarded seed poorer than their own.

The Department of Agriculture decided, therefore, to remedy this by investigating the varietal position and preparing descriptions of all the more important varieties, by commencing the production of high-quality seed for distribution to growers, and finally by inaugurating the certification of seed potatoes.

THE WORK OF THE DEPARTMENT OF AGRICULTURE.

The first step was necessarily the sorting-out of varieties and the preparation of descriptions by which they could be recognized. These type descriptions, now completed, form the second part of this article.

The second, and really more important step, was to study the factors that were lowering the productiveness of a large proportion of potato crops. It was proved most convincingly that a group of diseases collectively known as "virus" diseases was primarily, and in most cases wholly, responsible, and that these diseases were transmitted from plant to plant in the field, and from season to season, by means of the tubers. This knowledge led to two lines of action. Firstly, steps were taken to raise, by means of selection, lines of seed as far as possible free of virus disease. This work, started at the Ashburton Experimental Farm, is now one of the more important activities of the Government Pure Seed Station at Lincoln, from which institution seed-stocks of all the more important varieties have been available to growers each season. Secondly, the Fields Division commenced in 1927 a system of seed-certification involving the trial of samples, the inspection of crops, culminating in the certification of such seed as had attained the necessary standard. The influence of certification upon the general standard of potato crops has been very striking. During the first few years from 25 per cent. to 30 per cent. of the crops were rejected on account of impurities. This was reduced in 1932–33 to below 1 per cent., and this past season of 1933–34 428 crops were inspected and there were no rejections on this account. The reduction in virus diseases has also been very marked, but the rapid distribution of virus disease in the field renders it less amenable to control. Nevertheless, it has been possible to tighten up the standards very considerably and yet to pass each season approximately the same proportion of crops.

The Purchase of Seed.

The grower who is not getting satisfactory results from his potato crop is advised to purchase certified seed. It may be too expensive to purchase sufficient to plant his whole area. If this is the case he should obtain sufficient to plant a seed-plot to supply his own requirements the following season. Two classes of certified seed are available, mother seed and commercial seed. The latter class, although not eligible for further certification, can be expected to give a good crop under average conditions. It will suit the grower who finds it necessary to purchase fresh seed at frequent intervals, and who requires a good line at a reasonable price. Mother seed, on the other hand, includes the best lines available, and is eligible for re-entry into certification. It should be purchased whenever possible, and always when the grower desires to make a business of growing for the seed trade.

The Maintenance of Pure Seed-stocks.

The purchase of certified seed must be regarded only as the first step towards crop-improvement. Such seed requires to be cared for if its standard is to be maintained. The chief method of maintaining this standard is by "rogueing"—*i.e.*, removing—all plants that appear for any reason at all to be not quite normal. It is not difficult to maintain varietal purity if reasonable care is taken. Unless a straight-out mixture of foreign varieties occurs, there are very few rogues that need trouble our New Zealand crops. Northern Star, or Gamekeeper, is the chief offender among the white skins. Because of its habit of producing a large proportion of seed it multiplies rapidly and tends soon to become

dominant in a crop. Leader and Scotia are two rogues which have caused trouble in the Dakota variety. The former is distinctly yellow-fleshed, and the latter turns dark on cooking, two very undesirable characteristics.

Rogues (foreign varieties) may be introduced into a line in a number of ways, and the greatest care in handling the seed is desirable. The accidental mixture of two varieties is always possible. Growing a crop on ground already carrying self-sown potatoes is perhaps the most common practice leading to mixing, and for this reason potatoes should not follow too closely after potatoes in the cropping rotation. Land in the vicinity of old potato-pits is always likely to carry self-sown tubers, and this should be kept in mind when growing for seed. Where two varieties are being grown in the one paddock, a break of some other crop should intervene. Even the differential effects of disease on two varieties may allow a rogue in a stock to multiply more quickly than the variety.

Rogueing should commence before the seed is planted. Apart from the beneficial effects on the succeeding crop, sprouting of the seed is one means of identifying rogues. Thus the pink sprouts of Northern Star contrast plainly with the purple sprouts of Arran Chief. The next rogueing for purity will probably take place at flowering-time. It is not necessary for the grower to be able to name all the rogues. He should have, however, in his mind a definite picture of the variety he is growing, and remove any plant that does not agree in all characteristics with this standard. Flower-colour, or even absence of flowers, is a definite means of locating some rogues, and at the flowering stage the general habit of growth of the plants also is clearly distinguishable. Unless influenced by disease, time of maturity is a very definite varietal characteristic and affords a useful guide for rogueing. Thus all plants of late maturity should be removed from the early variety, and *vice versa*. In all cases examination of the immature tubers leads to a more certain conclusion than inspection of the mature tubers, especially after pitting. In the former case the skin-colour and characteristics of the eyes are more readily distinguishable.

Variations known as "bolters" and "wildings" are to be found in many varieties. Bolters may be observed commonly in Up-to-Date and Epicure, and are recognized very easily in the latter. The plants are tall and of later maturity, produce a relatively large number of flowers, and may be more resistant to such diseases as late blight. The stolons are long and the tubers generally large and coarse. Such plants should be rogued, for they represent an undesirable variation from the normal, more especially in an early variety such as Epicure. Wildings are short in growth and produce an abundance of stems bearing no flowers. As might be expected, such plants produce a large number of tubers of seed-size with few table potatoes, and if they are not removed the stock deteriorates very rapidly.

The Maintenance of Healthy Seed-stocks.

While it is a relatively simple matter to keep a variety pure, the maintenance of a vigorous, disease-free stock is a much more difficult matter. Degeneracy or "running out" of a line is mainly brought about by a group of diseases known collectively as virus diseases.

That low yield and a high percentage of virus infection are correlated has frequently been demonstrated, and the following figures are quoted as a typical example.

Number of Lines in each Group.	Limits of Yield in each Group, in Tons per Acre, of Cropping-power.	Average Percentage of Virus Infection for the Lines of each Group.
1	11·5–11·9	7
Nil	11·0–11·4	..
4	10·5–10·9	16
2	10·0–10·4	16
6	9·5– 9·9	18
5	9·0– 9·4	17
6	8·5– 8·9	18
5	8·0– 8·4	19
4	7·5– 7·9	20
7	7·0– 7·4	22
9	6·5– 6·9	23
11	6·0– 6·4	33
6	5·5– 5·9	37
11	5·0– 5·4	43
6	4·5– 4·9	43
4	4·0– 4·4	45
3	3·5– 3·9	62
1	3·0– 3·4	61
4	2·5– 2·9	68
1	2·0– 2·4	76
1	1·5– 1·9	94

These results were obtained in New Zealand in the certification-tests which are essentially concerned in identifying stocks, which, among other considerations, are relatively free from virus diseases. The following figures published recently in a report of results obtained at the Plant Research Station, Palmerston North, support the soundness of using certified seed, and are quoted here to demonstrate how rapidly seed may deteriorate.

	Tons per Acre.
Certified seed averaged	14·3
Seed once grown from certified seed averaged ..	11·6
Seed twice grown from certified seed averaged ..	10·1
Seed three times grown from certified seed averaged	10·1
Uncertified seed averaged	7·6

Rogueing for Virus Disease.

Virus diseases are carried over from year to year in the seed, but an examination of the tubers does not reveal their presence. In fact, such tubers often keep better than healthy seed. The virus is carried in the sap of the diseased plants, and is capable of setting up the same disease in another plant, when it reaches the sap of that plant, by inoculation or by grafting. In the field such inoculation takes place by

means of insect agencies, chiefly aphides, which, when moving from plant to plant, carry infection on their feeding parts. Only by inspection of the growing crop can the presence of these diseases be detected, and therefore it is to the growing crop that attention must be paid. If a stock is badly infected, rogueing is not worth while. Such seed should be discarded and a good certified line procured, and to keep even such stock healthy thorough and persistent rogueing is necessary. Since infection is transmitted in the field it is necessary to rogue as early as possible, about six to eight weeks after planting. For practical purposes it is not necessary to identify each disease; a much more thorough rogueing will be accomplished if every apparently weak or unhealthy plant is removed. Windy and showery weather should be avoided, and bright sunlight is not desirable, as the shadows cast by the upper leaves are confusing. Dull, calm weather is the most satisfactory. If it is imperative, through pressure of other work, to rogue on a sunny day, then the operator should keep his back to the sun, which will mean working in one direction only.

Recognizing Virus Disease.

Authorities differ in classifying the many virus diseases: a plant may carry more than one of them, and their actual identification becomes very difficult. The following notes will assist, however, in the recognition of the more common.

Leaf-roll.—In this virus the lower leaves are rigid, the leaflets thickened and harsh, and rolled upwards and inwards, making the leaf funnel- or spoon-shaped. The rolled leaflets are crisp and dry, and rustle when the plant is disturbed. When a healthy plant becomes infected during the growing season there may be no visible sign of infection, but occasionally a *stiff* upward rolling of the topmost leaves takes place, extending progressively to the lower ones. Other diseases, particularly stem-troubles, are the more usual cause of the upper leaves curling, but stem-troubles are usually accompanied by a certain amount of wilting. In leaf-roll the old sett is not generally exhausted. All stages of infection occur, and in severe cases the plant becomes much dwarfed and incapable of yielding table-sized tubers. Unfortunately, the produce from such plants normally finds its way into the seed from which next season's crop is propagated. Aphides and other insects distribute the disease in the field, and the seed-tubers from infected plants carry the trouble from one season to the next and from one grower to another.

Mosaic.—Several types of mosaic have been described, and each is now recognized as a distinct virus. In the usual form, instead of being uniformly green, the leaflets are mottled with pale green patches. This condition is recognized most easily if the plant is shaded from the direct rays of the sun. In severe cases the foliage becomes paler, the growth more open, and the leaflets very much wrinkled or the margins of the leaflets waved. The whole plant is dwarfed and the yield considerably reduced. The mottling is to a large extent masked in hot sunny weather, and recognition of mild mosaic becomes very difficult. Infection is carried in the same manner as in the case of leaf-roll.

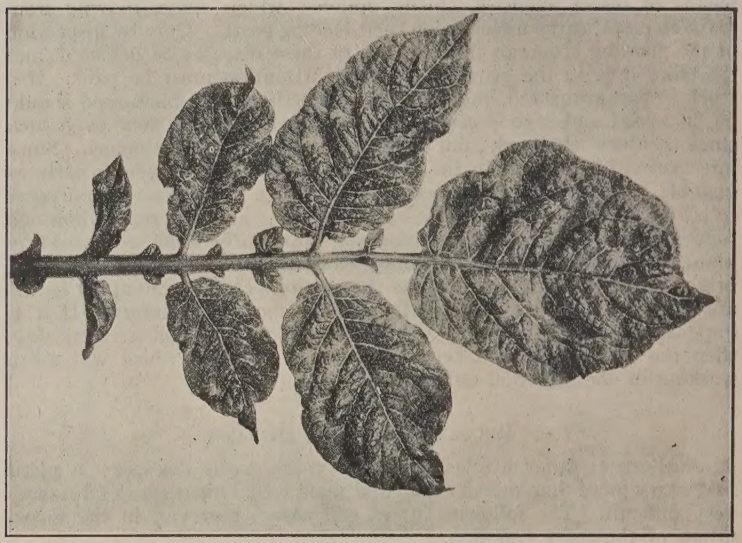


FIG. 1. MILD MOSAIC.

FIG. 2. LEAF-ROLL.

Crinkle.—In many ways this disease resembles severe mosaic. The plants are always very much dwarfed and the leaves crinkled. This appearance can be detected almost as soon as the plants are through the ground. The leaves are very much mottled and curled downwards. The lower leaves often turn brown and drop off and the plant matures at an earlier date than healthy plants. The yield is greatly reduced.

Stipple-streak.—In attacks of this virus the leaflets develop characteristic dark angular spots, which spread down the veins of the leaflets and extend to the midrib of the leaf. In advanced

FIG. 3. LINE OF POTATOES (CENTRE ROW) BADLY "RUN OUT" WITH LEAF-ROLL.
Such plants are a menace to healthy plants around and to healthy crops in the neighbourhood, infection being spread in the field by insects such as green aphis.

cases the lower leaves fall, leaving only a tuft at the top and giving the plant a palm-like appearance. The yield is affected very adversely.

Spindle-sprout.—Tubers which develop thin weak sprouts should be discarded. The plants which grow from such tubers are at best weak and unproductive. Rogueing in this case is effected also at planting-time, and the sprouting of the seed is a great advantage in this direction.

Other Diseases of Importance.

Although virus diseases are the most important, there are others that must be taken into consideration. Some of these are carried over in the tubers and affect the growing crop, others are storage diseases. All are of importance in that they reduce the quality of the seed and affect the subsequent crop, either in quality or quantity of produce. The grower of certified seed must adhere rigidly to the practice of marketing only absolutely sound seed. Even with the greatest of care odd damaged or diseased tubers get by, and under suitable conditions may set up serious trouble

FIG. 4. SINGLE-PLANT SELECTIONS OF HEALTHY AND OF VIRUS-INFECTED ARRAN CHIEF.

During the growing season of 1926–27 some healthy and virus-infected plants were marked. The produce of each plant was kept separate and planted during the 1927–28 season. The photo shows the growth during the latter season of this one healthy and one virus-infected selection. This demonstrates very clearly the transmission of virus disease from one season to another by means of the seed tubers.

in a line. In districts where late blight is prevalent spraying the crop with Bordeaux mixture should be adopted and the tubers subjected to a vigorous inspection, as this disease may develop and spread with disastrous results in storage. Great care should be exercised in digging and handling. Spores of the well-known storage disease "dry rot" are always present and gain entry through any fork marks or bruises, setting up the rot, which may be responsible for serious losses before the seed is planted. Eelworm and powdery scab can be seen on the surface of the potatoes, and

any tubers showing symptoms of these should be discarded, as under favourable conditions they may infect the subsequent crop, and in any case carry infection to the soil in which they are planted. Precautions should be taken against the potato-moth. Thorough moulding of the crop is the best preventive. Infected tubers should not be put into storage, as the pest may increase, causing serious damage to the whole line.

Other diseases likely to be encountered are wilts, mattery eye, and blackleg. These cause the upper leaves to become rolled and flaccid, generally commencing with one stem. Later the whole plant may wilt and die down long before the healthy plants. Discoloration of the flesh of the potato, more especially near the vascular tissue of the stem end, frequently is associated with one or more of these troubles. In some crops infection is too high for rogueing to be practicable, but in the seed-plot all plants showing these symptoms should be dug at once and the haulms and tubers removed.

Emphasis must be laid upon careful handling of the seed and thorough inspection of the tubers. Several cases have come under notice where apparently sound seed has developed storage rots after it has been subjected to warm humid conditions favourable to the development of such diseases. What might happen when seed has been handled carelessly or damaged tubers allowed to pass in a line is therefore evident.

The Seed-plot.

To rogue efficiently a large area of potatoes takes time and labour. To buy fresh supplies of "mother seed" at frequent intervals is costly. The regular grower of certified seed is therefore advised to plant a seed-plot to supply his own requirements. Using his purchased line as foundation stock he should go through his crop about flowering-time and mark with sticks a large number of healthy plants which have also healthy neighbours. These marked plants should be examined periodically during the remainder of the growing-season, and the stick removed if any doubts arise regarding the health of the plant. It should be kept in mind that bolters, being more vigorous and disease-resistant than the rest of the crop, are likely to appear promising, and should be avoided.

As the greatest spread of virus takes place later in the season, the marked plants should be dug in an immature state, as soon as good seed-sized tubers are formed. When digging, a standard should be set, say 6 to 8 tubers of average size per root, and any plants falling short of this should be rejected. The seed should be "greened" and stored under the best conditions available, in shallow trays if possible. By this means sufficient seed could be procured for the planting of a seed-production plot.

This plot should be isolated from all other potatoes, on land that has not grown potatoes for several years. The importance of isolation cannot be overstressed. Probably the *worst* location would be a few rows down the centre of the main crop, where it would be liable to infection from all sides. Two varieties should not be grown side by side. It has been proved that certain

varieties carry virus in a masked form and, while exhibiting no outward symptoms whatever, are yet a possible source of infection to another variety. Once established, the seed-plot should be rogued carefully.

This method is probably the most effective for the practical grower. It is systematic and based on sound principles, and at the same time avoids the disadvantages of the tuber-unit-selection or the hill-selection methods, which are slow and involve a large amount of detail and labour.

Cultural Operations and the Use of Fertilizer.

Experience has shown farmers generally the most satisfactory cultural methods for the crop in their particular district. There are one or two points, however, worthy of special mention. A large number of experiments carried out over a wide range of conditions has proved definitely that the judicious use of artificial manures is profitable. As a result of these trials the following recommendations are made :—

(1) On the lighter to medium-class potato soil use up to 3 cwt. superphosphate per acre. On the rich alluvial potato soils use up to 5 cwt. superphosphate per acre.

(2) Use 1 cwt. sulphate of ammonia per acre in addition to the superphosphate recommended above on all soils.

(3) Experiments indicate that 1 cwt. sulphate of potash, in addition to superphosphate and sulphate of ammonia, is likely to be profitable if used in districts represented by the following centres: Kirwee, Mitcham, Temuka, Taieri, McNab, and Gore. Until further information is available, potash is worth a trial as an addition to superphosphate and sulphate of ammonia on a small scale in districts not mentioned above.

(4) Where mechanical means of distributing fertilizers are not available, hand-distribution should certainly be carried out, either by sowing from a bucket or by using some knapsack-type of hand-distributor, such as those used for hill-country top-dressing.

(5) When the fertilizer is being applied by hand it should be spread in a strip about 3 in. to 4 in. wide along the bottom of the furrow in which the potatoes are to be planted. Confining the manure to a narrow strip is likely to render it more efficient than broadcasting it over the whole width of the furrow. Contact with fertilizers used at the rates recommended is not likely to damage the sprouting of the potatoes so long as the manure is spread before the potatoes are planted. If, however, cut seed is used it would be advisable not to allow the manure to come too freely in contact with the potatoes.

For the early potato crop in the Pukekohe district special conditions prevail. Recommendations based on trials in this district are as follows :—

(1) Use 8 cwt. to 11 cwt. of superphosphate and 4 cwt. to 6 cwt. sulphate of ammonia.

(2) Although it has been the regular practice to use potash on the early crop, trials have shown that it is of little value so far as its effect on yield is concerned.

To prevent increased acidity growers using sulphate of ammonia certainly should lime their land after the potato-cropping is completed in the rotation. About 1½ cwt. of ordinary ground limestone is required for every hundredweight of sulphate of ammonia used.

Weed-growth should be kept down in the growing crop. Weeds rob the crop and at the same time make rogueing difficult. Frequent harrowings across the rows until the plants are even 6 in. to 9 in. high, combined with the use of the horse-hoe between the rows, keeps weeds well under control.

Thorough moulding is essential to reduce the attack of the potato-moth and also to check spores of late blight from being washed down to the tubers. The mould should be brought to a narrow top. A wide or hollow top is almost useless.

If a digger is employed, ample soil should be brought up to have a cushioning effect on the potatoes. Tubers are often undamaged by the shoe, but may be badly bruised on the apron through not bringing up sufficient soil with them.

Handling of Seed.

The greening and sprouting of the seed is an important matter. This should be carried out wherever possible by spreading the seed out in a shallow layer in subdued daylight. Reference to the advantages of adopting this measure has already been made under the headings of rogueing for foreign varieties and for spindle sprout. Additional advantages are an earlier "germination," and a much more vigorous and even stand; any tubers not sprouting or showing weak sprouts should be discarded. Allowing the tubers to make long spindly sprouts and then rubbing these sprouts off definitely weakens the tuber and affects the subsequent growth. Experience has shown that greened and sprouted tubers can be cut with less danger of missing than can unsprouted seed.

The practice of cutting table-sized tubers into setts for planting is one to be recommended when the market price of table tubers is low. An improvement in the general standard may be effected in this way because large tubers are likely to be the produce of relatively healthy plants, while seed-sized tubers may be, and very often are, the produce of poorly-productive diseased plants. Care has to be taken, however, in the handling of cut seed. Some varieties, notably Auckland Short Top, Auckland Tall Top, Majestic, and King Edward, will not stand cutting as well as others. In these cases particularly strict attention should be paid to the handling of cut seed. The safest precaution is not to permit the cut surface to dry. Even exposure for half an hour may be disastrous, and the setts should be planted in moist soil and covered at once. Covering the setts with wet sacks, and even handling them in wet sacks during planting, are wise precautions. It is advisable not to cut large quantities, but to cut as required. If, however, they have to be stored they should be spread out to avoid any danger of "sweating" and kept moist with a covering of wet sacks.

Varieties.

Although many varieties of potatoes are grown in New Zealand only about a dozen are of real commercial importance. The following table, compiled from entries received for certification, indicates the popularity of the more common New Zealand varieties.

Potato Certification: Acreage provisionally certified.

Variety.	1929–30.	1930–31.	1931–32.	1932–33.	1933–34.
Auckland Short Top ..	96	298	352	238	357
Dakota	132	270	145	146	261
Auckland Tall Top ..	56	86	92	53	42
Arran Chief	6	18	26	58	164
King Edward	25	30	21	27	25
Up-to-Date	3	11	22	11	9
Epicure	29	56	31	14	9
Iron Duke	12	23	7	9	22
Bresee's Prolific	78	107	31	33	10
Arran Banner	..	..	3	18	60
Early Regent Bolter ..	..	..	1	6	16

For a general all-round variety combining moderate earliness with cropping ability and quality, Auckland Short Top is deservedly the most popular. Unfortunately this variety has a particularly thin skin and bruises easily in handling. For the lighter warm soils of Canterbury Dakota gives satisfactory results, and has in addition the merits of being a splendid keeping and cooking variety. Arran Banner is an excellent cropping variety, but unfortunately has been grown extensively on the heavy soils, where it develops very large tubers, very deep in the crown end. It should be grown on the medium potato land. For the very rich land Iron Duke is probably the heaviest cropper. As, however, this variety is very late, it should not be grown on land subject to water-logging in the late autumn. In the southern districts King Edward does very well as a second early. Arran Chief is the most popular main-crop variety in those parts, and in fact is well suited to any heavy potato-land, particularly in the colder localities. Bresee's Prolific has been grown extensively on the light, dry soils, but is losing its popularity on account of its susceptibility to brown fleck. Aucklander Tall Top is also waning in popularity on account of its very late maturity and tender skin. In the Pukekohe district the Northern Star variety is practically the only one grown, and this is chiefly on account of its ability to produce a second crop from seed dug the same season.

ACKNOWLEDGMENTS.

Acknowledgments are made to the following: J. W. Hadfield, Agronomist, for assistance and co-operation in preparing and revising this article; J. H. Claridge, Assistant in Agronomy, for the tables in connection with seed-certification; A. W. Hudson, Crop Experimentalist, for the particulars dealing with manuring and other assistance; J. C. Bell, Instructor in Agriculture, for particulars dealing with manuring in the Pukekohe district.

Part II will deal with varieties, their description and economic value.

The club-root organism was isolated from soil not previously in brassicas for four years and a half, and found to be pathogenic.—*Report, Mycologist.*

LIVE-STOCK POISONING IN NEW ZEALAND.

B. C. ASTON, Chief Chemist, Department of Agriculture.

(Continued from January, 1935, Journal.)

EFFECT OF INDIGENOUS PLANT POISONS ON ANIMALS.

THE family to which tutu belongs, *Coriariaceae*, is one which contains the single genus *Coriaria*, comprising some ten or a dozen closely related species scattered over the world, mostly in alpine or sub-alpine situations, in New Zealand, Mexico, the Andes, Japan, China, the Himalayas, North Africa, and South Europe, a very curious distribution. From the European species *C. myrtifolia*, "redoul," which was first investigated by Riban in 1863, the crystalline poisonous principle coriamyrtin was isolated. This is similar in its physiological action to tutin, but more toxic. In recent years two Japanese chemists, Kariyone and Sato (*Jour. Pharm. Soc.*, Japan, Feb., 1930), have isolated both these principles from the Japanese species (*C. japonica*). Although so closely related to one another, the species seem to vary greatly in their relative effects on animal life. The European species is highly toxic to higher life, and persons have been poisoned in France from drinking senna tea made from senna leaves adulterated with *Coriaria* leaves. Snails fattened on the leaves of the redoul, although themselves apparently unaffected, poisoned several persons who ate the snails at Toulouse, France. On the other hand, green beetles fed on the leaves of the New Zealand plant *C. ruscifolia* failed to poison a fowl when it was fed on the beetles. That birds are little susceptible to some vegetable poisons has already been shown in the case of domestic fowls and pigeons dosed with tutin. It is also reported that the flesh of the Argus pheasant of Malaya is poisonous owing to the poisonous nature of its vegetable food, the bird itself being unaffected. The Himalayan species, *C. nepalense*, is a staple food for the herds of animals in Nepal, and the herdsmen eat large quantities of the fruit without ill effect. The seeds of the New Zealand species are undoubtedly poisonous, but if these seeds are strained off the pulp surrounding them the pulp is not only innocous but was highly esteemed by the Maoris as furnishing an agreeable drink.

It will be convenient here to consider in some detail the manner in which New Zealand poisonous plants affect domestic stock, and the methods which have been adopted or suggested for treating an animal which is suffering from eating a poisonous plant when the identity of that plant is known or strongly suspected.

There are three distinct stages in the investigation of poisonous plants: The first, when, owing to the accumulation of a number of facts by farmers and other observers, a plant becomes suspected of being a potential danger to stock. The second is when the plant is fed and found to produce poisoning symptoms in some test animal corresponding with the symptoms found in the field under natural conditions. The third is where the chemist separates either a substance in which the active principle is concentrated or

a substance which may be the principle itself in a more or less pure state. By giving minute doses of the concentrate or the principle to an animal the same symptoms are produced that result from the eating in large quantities of the plant itself. An example of the concentrated extract is the resinous matter which alcohol dissolves from *Pimelia* (Strathmore weed), the bark of which is poisonous to guinea-pigs (see Leaflet to Farmers No. 55, issued in 1900, or p. 311, 1900 Rept. of the N.Z. Dept. of Agric.). The value of the last method, at its best, is that the true action of the pure active principle may be obtained unclouded by the action of other compounds which may exert a distinct effect on the animal. The pure principle may also be injected directly into the blood system of the animal instead of having to be absorbed through the digestive system as when the plant is given by the mouth, and this method of injection usually is preferred by physiologists as being the more reliable. The isolation of the pure active principle is, however, often a matter of great difficulty to the chemist, but when it is accomplished the interest of pharmacologists is aroused, and they give their attention with enthusiasm to the discovery of the exact way the animal reacts when dosed with the principle.

Generally speaking, tutin, the crystalline active principle of all the three New Zealand species of the tutu plant, is rapidly fatal to all kinds of life. Fitchett and Malcolm proved that tutin was poisonous to cats, rabbits, guinea-pigs, pigeons, lizards, frogs, fishes, insects (house and blow flies), larvæ (blowfly maggots), shellfish (molluscs and cockles), *Infusoria* and *Amoebae*. On some bacteria, but not all, tutin had a deleterious action, but did not have any effect on yeast cells, which caused vigorous fermentation in glucose, even when 0·4 per cent. of tutin was present in the solution. With regard to the response of larger animals, no results of any ill-effect of tutin on ruminants or horses appear to have been published. There is some doubt if horses have ever been poisoned by the plant, Laing and Blackwell ("Plants of New Zealand," 1906, p. 228) state that horses have been known to eat freely of this plant without evil effects. Featon ("Art Album of New Zealand," p. 104), however, a non-scientific writer, states that it is generally asserted that horses will not eat the tutu, but had evidently heard some opinions to the contrary. Haast (*Trans. N.Z. Inst.*, Vol. 2, p. 299) describes the death of an elephant attached to a travelling menagerie in Otago, which, after feeding on herbage containing tutu for four hours and drinking a long drink from a creek, fell to the ground and died three hours later. Haast thought it remarkable that the elephant should, like cattle and sheep, eat the plant while horses will not touch it; but from the author's own knowledge there is no doubt that horses do eat tutu in moderation. It is noteworthy that the first animal to be experimented upon with the active principle was a pig. Dr. Gilruth has recorded the details in dosing a pig weighing 35 lb. with two grains of tutin, which was fatal to the pig in five hours (p. 142, 1900 Rept. of the N.Z. Dept. of Agric.).

Different animals are susceptible to tutu in different degrees according to the species. Fitchett and Malcolm found the minimal lethal dose was as follows, expressed in milligrams (1 mm. equals $\frac{1}{65}$ grain) of tutin per kilo (2·2 lb.) of animal body-weight: cats

0·75, guinea-pigs 2·0, rabbits 2·5, lizards 3 to 4, birds 10·5—all by administration by the mouth; frogs 10·5—given hypodermically; fishes 50·0—when immersed in the solution. The smallest dose which was certain to kill a medium-sized rabbit was found to be 2·5 mm. ($\frac{1}{26}$ grain). It was found that birds could withstand very large doses—10 milligrams per kilo of tutin administered by mouth. Attempts to poison a common fowl and a pigeon with the "berries" and dried seeds of tutu failed, and the author doubts if birds can be poisoned by eating berries, owing to the large quantity that would have to be eaten. Easterfield and Aston (*Trans. N.Z. Inst.*, Vol. 33, p. 346, 1900) reported that fowls had been affected by the seed (freed from the pulp). In their article, however, the word "berries" was inadvertently used instead of seeds. These authors found the highest amount of tutin in the plant to be 0·03 per cent., which was present in the young shoots. Fitchett and Malcolm state that tutin does not appear to be destroyed readily in the body or excreted, for it was found that medium doses given to a guinea-pig every second day caused death after the fifth dose. This suggests that stock may be poisoned by eating moderate quantities of tutu day by day, the poison accumulating until enough is present in the blood and tissues to cause the symptoms to appear. The question of acquired tolerance was also investigated by those authors, but no determinate conclusion was reached, although the evidence seemed to indicate that tolerance may be established in a high degree in animals which ingest small quantities of tutin over long periods.

Treatment of Poisoned Stock.

The method of treatment of stock when poisoned by specific poisonous plants is a wide field, and one on which the veterinarian who has made *Materia Medica* a study is best able to give advice.

Those who would like to examine the findings of Professors of Pharmacology should read the researches of Dr. C. R. Marshall in *Trans. of Royal Society of Edinburgh*, Vol. 47, pp. 286–316, 1910, abstracted in the proceedings of *N.Z. Inst.*, 1911, page 27. There the pharmacological action of the pure crystalline active principle of tutu, called by chemists "tutin," is set forth.

The same authority, in the 1905 Rept. of the N.Z. Dept. of Agric., p. 79, has given practical advice on the treatment of the stock poisoned by the tutu plant as follows: He had found no antidote for tutu poisoning, and doubted if any true antidote would be found. For animals, the best treatment if they will lie still is to leave them alone. An animal will recover from large doses of tutu if it will remain quiescent, but unfortunately they develop a tendency to run about. Bleeding is certainly very beneficial, and if animals show any tendency towards convulsions it is best to bleed them and inject a small amount of chloral-hydrate in a large volume of 0·8 per cent. common salt solution. Dr. Marshall also gave some valuable information as to the treatment of children suffering from tutu poisoning, which was communicated to the Health Department.

Later physiological investigators were Dr. Fitchett and Professor Malcolm, working in conjunction in Dunedin, and their results are

summarized in the annual report of the Department, 1908, p. 221. In the main they confirm the previous advice given by Dr. C. R. Marshall—that is, the administration of chloral and bleeding. For the treatment of stock they recommend the administration of lime-water and preferably the stronger "liquor calcis saccharatus" of the British Pharmocopœia. The use of the stomach tube where possible would not only render the administration easier, but might also allow of the escape of the gases which accumulate in the stomach in most cases. There is a distinct value in the suggestion that "tuted" animals should be disturbed as little as possible. They believe that once convulsions are initiated a vicious cycle is established—convulsions beget convulsions.

In the *N.Z. Journal of Agriculture*, 1917, Vol. 15, page 307, Mr. A. R. Young, M.R.C.V.S., then Director of the Live-stock Division, gives the following practical directions for stock poisoned by the tutu plant:—

All the information in our possession at the present stage warrants us in dividing, for all practical purposes, tutu poisoning into three degrees of severity:—

(1) When the animal has consumed a large amount of tutu, in which case there is no cure; (2) when the amount of tutu eaten is not sufficient to cause rapid developments, in which case cures should be tried, and may be successful; (3) when tutu has been eaten in small quantities (as is common) and the animals recover of their own accord, and then soon acquire a certain amount of tolerance to the effect of the plant.

As to treatment, it may be stated in the first instance that nearly every stockowner or drover has his own absolute cure, which is usually promptly condemned by others who try it. However, taking the action and symptoms induced by the poison, I would place treatment in the following order: Bleeding from the neck, or if the animal possesses horns these should be sawn off close to the head. This will allow of sufficient bleeding. Administer also (if this can be done) a dose of Epsom salts to clear out as much of the poison as possible, and when the animal, as is generally the case, gets "blown" introduce a probang through the mouth right into the stomach; then withdraw the stiletto and allow the gas to escape. Before withdrawing the probang a funnel can be placed in it, and small quantities of medicine introduced right into the stomach, thereby avoiding the risk of choking. A quantity of lime-water, a cupful or more of a solution of ammonium bromide and potassium bromide, 2 drams of each, dissolved in the water, or 2 drams of chloral hydrate in the same quantity of water, may do a great deal of good.

When there is much excitement and it is dangerous to drench, hypodermic injections can be used, such as 2 grains of arecolin, followed by the trochar and cannula. This instrument is introduced into the large stomach by plunging it into the left flank, taking as a guide about a hand-span from the last rib, the wings of the spine, and the haunch-bone. Afterwards withdraw the trochar, and leave in the cannula, through which the gas will escape.

Many cases will be found, however, where energetic treatment must be at once adopted, and little time is allowed to secure instruments or drugs. In such cases a sharp pocket-knife will draw blood, and can also be used instead of a trochar and cannula, the finger or neck of a bottle being used to keep the wound open. A larger opening at this spot could be made and the whole of the contents of the stomach removed, but this requires considerable experience, as care must be taken that no fluid or other material is allowed to escape into the abdominal cavity. The stomach, as also the flank, requires to be stitched up afterwards, and the animal kept on a low diet for a few days.

It may be mentioned that a cow heavy in calf is apt to slip it if she has eaten sufficient tutu to cause convulsions or hoven, but should the poison not so act at the time and the fœtus live, there should be no interference with natural calving.

It is remarkable that poisoning of animals by tutu seems to have a permanent injurious after-effect on the nervous system of the animal, persisting even after the animal has apparently recovered from the grosser results of the poisoning. The writer has been assured by a Taupo farmer that sheep that have been "tuted" never associate with their fellows again, but follow a solitary existence. In Elwell's "Boy Colonists," published in 1878, p. 34, it is recorded that sheep seldom thoroughly recover after tutu poisoning; they are generally apparently affected in the brain by it, for they wander along after its physical effects have passed away and nothing will induce them to join their fellows.

Four cases of loss of memory in human beings are quoted by Christie (*N.Z. Medical Journal*, No. 4, Vol. 3, July, 1890) as a result of eating tutu berries. Fitchett (*Trans. N.Z. Inst.*, p. 290, Vol. 41, 1908) adds others, in one of which mental change occurred which was permanent after the acute symptoms had subsided. A writer to the *Otago Witness*, 7th February, 1928, confirms this loss of memory in "tuted" victims, recording that one suffered from a mild form of St. Vitus's dance ever since the poisoning.

Dr. Lauder Lindsay also records similar effects in humans. Fitchett remarks that loss of memory appears to occur also in the lower animals, for shepherds have observed that a "tuted" lamb which has recovered does not know its own mother, and the ewe may be seen following her lamb and striving to excite recognition.

With regard to the curative treatment for plants other than tutu, it has been seen that brisk exercise is the bushman's remedy in cases of poisoning of horses by rangiora (*Brachyglottis*), and in cases of bracken fern, which is a slowly acting poison, the obvious remedy of removing stock to a paddock where no fern is obtainable is successful—this *Journal* (Vol. 1, p. 215, 1910), where a case of poisoning is described by Hickman, M.R.C.V.S. The above advice for fern poisoning is repeated in this *Journal* for February, 1926, page 139, by the Live-stock Division, in answer to a correspondent, where it is recommended to supplement the actual pasture food by a few handfuls of linseed nuts and bran daily until the condition of the animals shows general improvement, and also to give each affected animal 12 oz. of Epsom salts and one tablespoonful of ginger in a quart of oatmeal gruel, sweetened with molasses.

For *Pimelia* (Strathmore weed), Webster, M.R.C.V.S. (*Journal*, 1926, p. 104), in the treatment of horses, recommends "a stimulant and purgative dose of linseed oil in the first instance, followed by linseed-tea, bismuthi carb., and strong coffee in liberal doses at four-hour intervals."

For ngaio poisoning in cattle, Webster (*N.Z. Jour. Agric.*, August, 1926, p. 105) states that from its characteristics the administration of demulcents and stimulants appears indicated.

(To be continued.)

The Fields Instructor, Greymouth, reports that *Poa aquatica*, introduced a few years ago by planting a few roots, has spread through wet swamp at Waitaia, and produces much feed which stock eat greedily and on which they winter well.

PAMPAS GRASS AND ITS IDENTIFICATION.

H. H. ALLAN and V. D. ZOTOV, Plant Research Station, Palmerston North.

SINCE the publication in this *Journal* (October, 1932, May, 1934) of articles by Mr. B. C. Aston on pampas grass as winter cow-feed, we have received numerous specimens from various localities with the inquiry whether they were specimens of pampas grass or not. In view of the economic importance of the grass it seems worth while giving a few details of its characteristic features, and of others likely to be confused with it—toetoe and Cunningham's danthonia.

In the flowering stage these grasses are easily distinguished after a little careful examination. A glance at a flower-cluster of Cunningham's danthonia (fig. 1) will show the features necessary

FIG. 1. SPIKELET OF CUNNINGHAM'S DANTHONIA, SHOWING THE PARTS MENTIONED IN THE TEXT.

for comparison. The whole cluster (spikelet) has at the base two empty delicate husks (glumes). Above these are the florets, each on a short stalk (rachilla). In the drawing are shown four florets, surmounted by an imperfectly developed one, the spikelet being somewhat spread out to show the parts more clearly. The essential parts of each floret are enclosed between two husks. The larger outer one (lemma) enfolds the inner more delicate one (palea). In Cunningham's danthonia the lemma ends in two fine teeth, from between which extends a long slender bristle (awn). At the approach of flowering the upper portion of the palea is pushed out from the lemma and is seen to be sharply folded at each margin. The essential parts (male and female elements) are thus exposed to view. In Cunningham's danthonia (fig. 2) each floret contains both elements. The ovary (later ripening to form

the grain) is surmounted by two stalks (styles) each bearing a feathery pollen-catching apparatus (stigma). The male element consists of three stamens. A stamen consists of a stalk or filament carrying the pollen-containing anther. The figure shows an early stage of development, and for clearness only the filament of the front stamen is shown.

With these points in mind the following key, along with the fuller descriptions given later, should enable any one to distinguish the three grasses here discussed.

1. Florets *not* obscured by very long hairs——2.
   Florets obscured by very long hairs——3.
2. Florets with both male and female elements (figs. 1, 2, 4)——*Danthonia Cunninghamii.*
   Florets containing male elements (stamens) only (fig. 3, d, e, f)——*Cortaderia argentea.*
3. Florets containing both male and female elements fully developed (fig. 5)——*Arundo conspicua.*

FIG. 2. FLORET OF CUNNINGHAM'S DANTHONIA, WITH THE HUSKS REMOVED.
(See also No. 3 and No. 8 in Fig. 4.)

Florets containing only female elements fully developed (imperfectly developed stamens may be present) (fig. 3, a, b, c)——*Cortaderia argentea.*

All three plants form exceptionally large tussocks, with long coarse leaves and large inflorescences.

In the absence of flowers the three species may readily be distinguished by a careful examination of the leaf-structure. The leaf of a grass is in two main portions, a sheath clasping the stem, and a blade free from it. At the junction of the blade and the sheath there is usually a band somewhat differently coloured from the rest of the leaf (the collar), and on the inner face at the junction is also a structure known as the ligule. In our three grasses the ligule is a line of densely placed short hairs and does not serve as a good differentiating mark. But the arrangement of the veins is very distinct, as shown in the following key:—

1. Prominent stout veins run parallel to the midrib in both sheath and blade (fig. 6, b, e)——*Arundo conspicua.*
   No prominent stout veins parallel to midrib——2.

2. Sheath rounded, not showing a prominent midrib, but with numerous short cross veinlets (fig. 6, a, d)——*Cortaderia argentea.*

Sheaths showing a prominent midrib, about which it is flattened; cross veinlets not clearly visible (fig. 6, e, f)——*Danthonia Cunninghamii.*

Pampas Grass.

The leaves of pampas grass (*Cortaderia argentea*) reach a length of 5 ft. or more, the lower part of the blade is erect; the upper

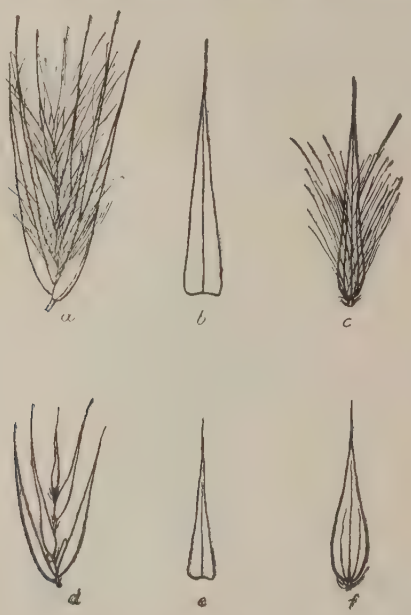


FIG. 3. PAMPAS GRASS.

(*a*) Female spikelet; (*b*) glume of female spikelet; (*c*) lemma of female floret; (*d*) male spikelet; (*e*) glume of male spikelet; (*f*) lemma of male spikelet.

part turned through an angle of 180 degrees. The sheaths are pale and somewhat brittle, with numerous fine veins connected by short cross veinlets, clearly visible when a portion of the sheath is held to the light. The broad midrib of the blade does not extend into the sheath. Above the ligule on the inner face there is a hairy portion, but this is much less developed than that found in toetoe. The blade is wider than that of toetoe, with numerous fine veins parallel to the midrib, but no development of especially stout lateral veins as in toetoe. On cutting across the sheath large air-spaces will be noted. The flower-stems are stout, solid, from 6 ft. to 10 ft. high, with erect feathery, silvery white or pinkish plumes, from 1 ft. to 3 ft. high, of densely placed spikelets. Each spikelet

FIG. 4. CUNNINGHAM'S DANTHONIA, FROM BUCHANAN'S "GRASSES OF NEW ZEALAND."

(fig. 3, a, d) has two to three florets. On the female plants these florets (fig. 3, c) are clothed in long silky hairs, obscuring the lemmas, which terminate in a fine awn (not arising from between teeth as in toetoe and Cunningham's danthonia). The male florets (fig. 3, f) lack the long silky hairs, and the white or brownish papery lemmas are clearly visible. The awn is as in the female floret.

Pampas grass is a native of the country from Southern Brazil to Northern Argentina. It has long been known and grown as an ornamental grass. In America it is cultivated rather extensively, the plumes of the female plant finding a ready market in London, Berlin, New York, and other large cities. The forage aspect has been fully dealt with in Mr. Aston's articles. The huge tussocks, with their densely crowded leaves, form a striking feature in landscape gardening, especially when in flower. It appears to have been first called "pampas grass" in Paxton's "Flower Garden" of 1850, but in its native haunts, *Cortaderia argentea* is practically confined to watercourses, and to depressions where there is a constant supply of moisture. It is absent from the great grass areas known as the "Pampas," so that the name is hardly appropriate, though now thoroughly established.

In New Zealand it has been much used as an ornamental grass, and has in odd localities become more or less naturalized. It appears to be a shy seeder with us, partly owing to the sexes being on separate plants, so that a plantation increased by vegetative means may be all of one sex. As the female plant is much the more handsome there are many more plants of this sex than of the male in gardens. I have no information whether one or the other sex is more favoured by stock, but certain strains may be more succulent than others.

Toetoe.

Toetoe (*Arundo-conspicua*), a graceful indigenous grass, also forms huge tussocks, almost rivalling those of pampas grass. The leaves are almost as long, rather narrower, more finely toothed on the margins. The strong, straw-coloured side nerves form a very marked differential feature (in some forms the midrib and larger side nerves are distinctly reddened). The sheaths are also nerved and much tougher than those of pampas grass, while the air spaces are smaller. The sheaths, too, when young, are covered by a bluish "bloom" absent in pampas grass. The flower-stems are up to 10 ft. high, more slender than those of pampas grass; the plume is from 1 ft. to 2 ft. long, rather less dense, and usually somewhat nodding and of a yellowish to brownish tinge. This brownish tinge is more developed in the very closely related species *Arundo fulvida*. The teeth of the lemma are prolonged into awns (fig. 5, 5).

This grass is distributed throughout New Zealand, often in large colonies. It favours swampy and damp ground, river-banks, and channels in the hillside. In some places it is also abundant on sand-dunes. Stock do not greatly like the plant as it grows, but it has been found to be more or less readily eaten when cut or chaffed. In a small hillside paddock near Feilding, containing much toetoe and

FIG. 5. TOETOE, FROM BUCHANAN'S "GRASSES OF NEW ZEALAND."

some pampas grass, a few cattle were recently turned in. In a day or two the pampas grass was eaten to the ground, but the toetoe was hardly touched.

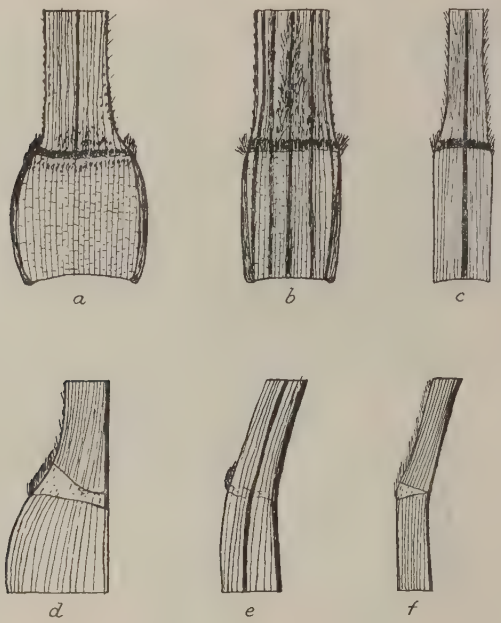


FIG. 6. JUNCTION OF BLADE AND SHEATH.
(*a*, *d*) Pampas grass; (*b*, *e*) toetoe; (*c*, *f*) Cunningham's danthonia.

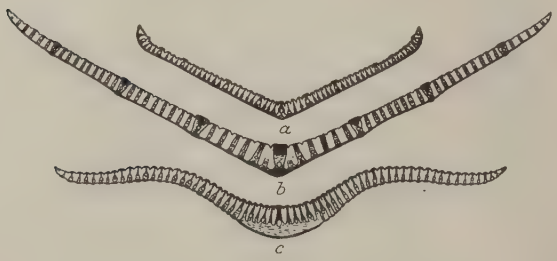


FIG. 7. CROSS-SECTIONS OF LEAF-BLADES.
(*a*) Cunningham's danthonia; (*b*) toetoe; (*c*) pampas grass.

Cunningham's Danthonia.

Cunningham's danthonia (*Danthonia Cunninghamii*) is another handsome indigenous grass. It does not as a rule form such large tussocks as the other two species, though in certain river valleys in North-west Nelson stately examples may be met with. The leaves are from 1 ft. to 5 ft. long, much narrower than in the other two species. There

is a much sparser development of hairs near the ligule than in toetoe, and the blades and sheaths lack the stringy side veins of that species. There are usually scattered hairs on the margins of the blade in the lower portion, and the teeth are very fine. The flower-stems are from 2 ft. to 5 ft. tall, the plume about 1 ft. high as a rule, but occasionally much larger, and much more open and spreading than in either pampas grass or toetoe, the spikelets standing apart on long slender stalks. The spikelets bear from three to seven flowers, and the hairs on the lemmas are short (fig. 4, 2), not concealing them.

This species is found through both Islands, but is absent from many areas. It is usually a montane grass, but in the South Island may be found along streams at low levels. Cattle and horses are fond of the plumes when these are in the early flowering stages.

For those possessing a lens and a sharp knife the shape and appearance of the cross-section of the blades will furnish a further means of distinguishing these grasses. Our sections (fig. 7) were taken from about the middle portion of representative blades. Heavy lines and darkened areas represent tough fibrous tissue. In such sections the differences of the venation are very clearly seen.

APHIDES AFFECTING CULTIVATED PLANTS.

(2) THE APHIDES OF THE POTATO.

W. Cottier, Entomology Section, Plant Research Station, Palmerston North.

In New Zealand there are three species of aphides commonly found on potato-foliage. These are *Myzus persicae* Sulz., *M. pseudosolani* Theo., and *Macrosiphum gei* Koch. While these are the characteristic aphides of potato-foliage they are by no means confined to this plant, and, in fact, they appear, in New Zealand, to be the most widely distributed species of the family.

In this country, as a general rule, mechanical damage done to potato-foliage by the feeding of these insects does not seem to be important, since it is very seldom that plants are so badly infested that they are visibly affected. The damage is done, however, by the action of the aphides in transmitting potato-virus diseases—*e.g.*, leaf-roll—the aphis most concerned with this transmission being *Myzus persicae*.

Below, an attempt has been made to describe the appearance of these aphides, and to discuss their economic significance to the potato crop.

Myzus persicae Sulz.

This insect is the smallest of the three characteristic aphides of the potato.

The wingless viviparous female (fig. 1, c) is most commonly a whitish-green to dark green, but it also may be shades of yellow and pink. The pink forms seem to be somewhat localized, being found in groups in various localities and not generally distributed. This wingless form is usually 1·5 m.m. to 2 m.m. long and presents a somewhat flat appearance.

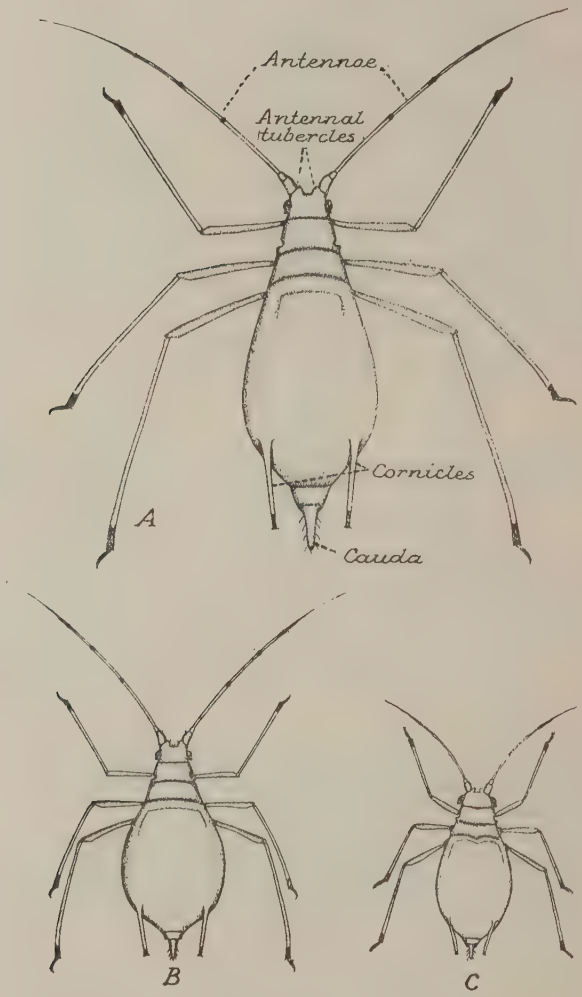


FIG. 1. WINGLESS VIVIPAROUS FEMALES OF—A, MACROSIPHUM GEI; B, MYZUS PSEUDOSOLANI; C, MYZUS PERSICAE. x 16 (approx.).

[*Original.*

The antennæ are slightly shorter than the body, the frontal tubercles project inwards and the cornicles are usually slightly swollen at or near the middle.

The winged viviparous female (fig. 2, C) has four wings, the front pair being much larger than the hind pair. The head and thorax are black, while the upper surface of the abdomen is greenish with black bands and has a large black patch in the centre. The cornicles are usually very dark and are swollen at or near the middle. The antennæ are approximately as long as the body. Length of the insect is 1.5 m.m. to 2 m.m.

HABITAT.

On the potato this insect is found on the undersides of the leaves and is fairly evenly distributed over the whole plant, but shows a preference for sheltered leaves such as those at the base.

NEW ZEALAND HOST-PLANTS.

M. persicae has been taken from the following plants: Potato, tomato, *Brassica* spp., peach, beet, green peas (*Pisum sativum*), docks (*Rumex* spp.), fat-hen (*Chenopodium album*), nightshade (*Solanum nigrum*), *Hebe* sp., Californian thistle (*Cirsium arvense*), *Daphne* sp., *Lilium* sp., *Chrysanthemum*, *Cineraria*, pansy, chickweed (*Cerastium vulgatum*), tobacco.

In other countries this aphis hibernates in the egg stage on such woody plants as the peach and nectarine. On reading literature one gains the impression that this is the commonest form of hibernation, but in New Zealand the situation is not as simple as this. In the southern portion of the South Island *M. persicae* is a serious pest of peaches, and the winter is certainly passed on these trees in the egg stage. These eggs hatch in the following spring and the insects cause very serious damage by sucking the sap and curling up the peach leaves. However, while the writer was engaged in studying the host-relationship of this aphis in 1929 and 1930 it quickly became apparent that the aphis can readily pass through our winter without having recourse to the egg stage. Specimens of *M. persicae* can be found feeding on *Brassica* spp. at almost any period of the winter, and these serve as sources of infestation to potato-fields.

MYZUS PSEUDOSOLANI Theo.

The wingless viviparous female (fig. 1, B) may be one of various shades of whitish-yellow, yellowish green to deep green, the commonest colour being rather a bright green. That part of the abdomen posterior to the cornicles is usually shiny. On the abdomen, at the bases of the cornicles, are darker patches of what appear to be collections of oil globules. The antennæ are green. The cornicles are cylindrical, green, with their apices dusky. The cauda is about one-third the length of the cornicles. Length of insect 2 m.m. to 2·5 m.m. See the figure for the shape of the antennal tubercles.

The winged viviparous female (fig. 2, B) is green, with the head and thorax darkened. The abdomen is decorated with dark transverse bars, and four dark lateral spots on each side. The antennæ are as long as, or a little longer than, the body, and are darkened. The

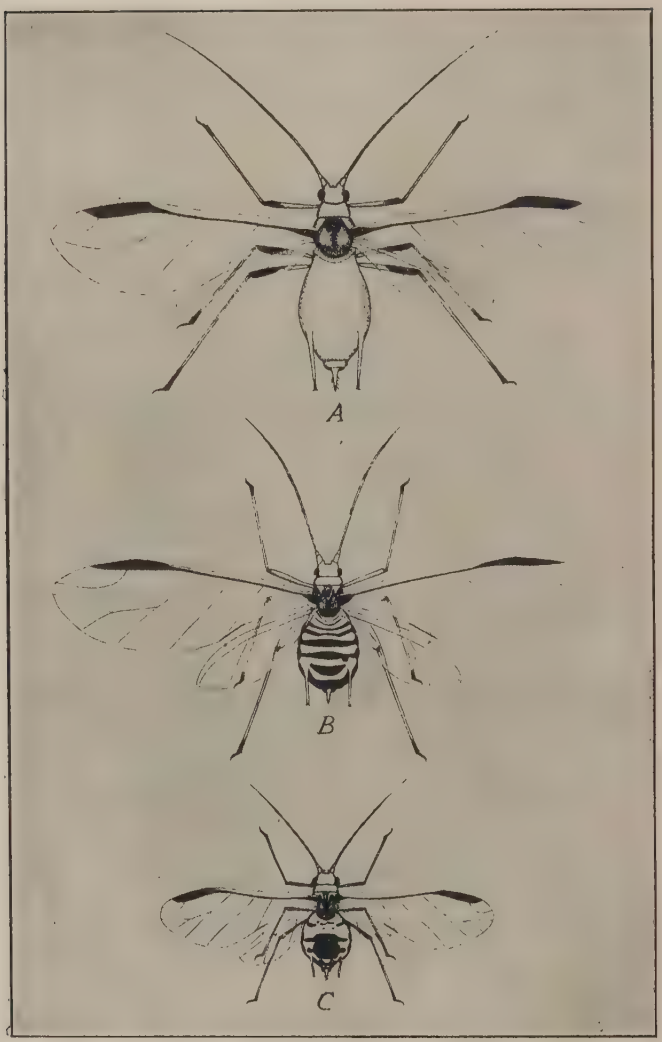


FIG. 2. WINGED VIVIPAROUS FEMALES OF—A, MACROSIPHUM GEI; B, MYZUS PSEUDOSOLANI; C, MYZUS PERSICAE. X 11 (approx.).
[*Original.*

cornicles are green and cylindrical, with the apices dusky. The cauda is green. Length of insect 2·3 m.m. to 2·5 m.m. The antennal tubercles are as in the figure.

HABITAT.

On the potato this insect shows a decided preference for the sheltered leaves near the ground. This habit is much more developed than in *M. persicae*.

HOST-PLANTS IN NEW ZEALAND.

The known host-plants of this aphis in New Zealand are: Potato, dock (*Rumex* spp.), foxglove (*Digitalis purpurea*), *Hydrangea* sp., *Abutilon* sp., buttercup, *Lychnis* sp., *Lilium* sp., chickweed (*Cerastium vulgatum*), poppy, *Geum* sp., *Buphthalmum* sp., pansy, nightshade (*Solanum nigrum*), *Coprosma grandifolia*.

In America, according to Miss E. M. Patch (1928), *M. pseudosolani* lays winter eggs on the foxglove (*Digitalis purpurea*). Although the insect has been found on foxglove in New Zealand, there is as yet no evidence gathered to prove that this form of hibernation is the rule in the Dominion. In Palmerston North the writer has frequently found the aphis breeding on the docks (*Rumex* spp.) in the middle of winter in fields which carried potatoes the preceding season. These particular aphides were of a light-yellowish colour. Also was this the case in Pukekohe in the North Island, where the early spring potatoes were just appearing above the surface of the ground among quite a number of docks. The aphis was abundant on the docks and was ready to move across to the potato-plants. This illustrates at least one method by which this insect can pass the winter.

MACROSIPHUM GEI Koch.

The wingless viviparous female (fig. 1 A) of this aphis is the largest of the species of this family on the potato, its average length being 2·8 m.m. to 4 m.m. The colour of the insect is green. The antennæ are usually longer than the body. The cauda is pale green, while the cornicles are large and green in colour, with their apices darkened. The cauda is about half the length of the cornicles. For the shape of the antennal tubercles see the figure.

The winged viviparous female (fig. 2, A) is usually green, with the head and thorax yellowish-green. The cornicles are cylindrical and green in colour, with their apices darkened. The antennæ are longer than the body. There are no marks on the abdomen. The average length of the insect is 2·9 m.m. to 3·3 m.m. For the shape of the antennal tubercles see the figure.

Young forms of this aphis usually have a light white mealy coating on the body, while all stages of the other two species are without this.

HABITAT.

On the potato this aphis much prefers the shelter of the lower leaves, where it may frequently be found in large numbers.

HOST-PLANTS IN NEW ZEALAND.

This aphis has been found on the following plants: Potato, tomato, apple, *Solanum* sp. (a hedge plant), rose, lettuce, sow-thistle, hawthorn,

Abutilon sp., *Gladiolus* sp., *Tulipa* sp., fat-hen, *Brassica* spp., *Lychnis* sp., carnations and pinks, *Hebe* sp., nightshade (*Solanum nigrum*), Californian thistle, poppy, *Chrysanthemum*, *Cineraria*, *Cerastium vulgatum* (chickweed), strawberry, dock (*Rumex* spp.), buttercup.

This aphis appears abundantly on the young shoots of roses in the early spring, and it is also very common at this period on the young leaf-shoots of apples. Later it may be found on the potato and other of its hosts. Miss Patch (1915) states that in America it passes the winter in the egg stage on woody plants, the rose being the favourite. Although in New Zealand this aphis does appear first in numbers on the rose in the spring, which fact suggests over-wintering eggs, endeavours to find such eggs have failed up to the present. Another favourite host-plant is the sow-thistle (*Sonchus oleraceus*), and the writer has found the young succulent parts of these plants overcrowded with colonies of *M. gei* shortly after the potato crops have died off. The insect is still on the thistle at the middle and end of the winter, although in much reduced numbers.

It has also been found sparsely on such roses as ramblers in mid-winter. There is no doubt that the insect can pass the winter in the asexual stage, provided suitable host-plants are available, and this seems to be the commonest method by which *M. gei* passes the cold season. It should be stated that these observations were made in the vicinity of Palmerston North.

The Significance of the Presence of the Aphides on Potato-foliage.

As stated at the beginning of this paper, the presence of these aphides on the potato is important, not so much on account of the effect in withdrawing the sap from the plants as in the part the aphides play in transmitting virus diseases—*e.g.*, leaf-roll and mosaic. The term "virus" is well known to potato-growers, and it is almost superfluous to explain that these diseases are carried in the sap of plants. Aphides feed by sucking the sap, and if they happen to be feeding on a virus-infected plant they take in the virus with their food. When such infected aphides feed on healthy plants they inject the virus into the vegetable tissue, and in time the plant will exhibit the typical diseased condition. Virus diseases cause what is known as "degeneration" or "running out," and, according to Whitehead, Currie, and Davies (1932), "it has also been proved that virus diseases alone are responsible for degeneration, or that, if other factors are involved, they fluctuate with virus diseases," which means that the amount of virus disease present is an index to the amount of degeneration.

Of the three aphides characteristic of potato-foliage, only one, *Myzus persicae*, has been shown to be of real importance as a virus vector, and by far the greatest amount of spread of the disease is due to this insect.

In the British Isles it has been a common practice to obtain "seed" potatoes from Scotland because it has been found that such "seed" has not degenerated. The reason for this has been ascribed to the absence of insect vectors in the Scottish growing-areas, and Welsh authorities have considered it worth while to endeavour to discover whether good "seed" growing areas, where degeneration does not occur, could be found in Wales (Whitehead, Currie, and

Davies (*loc. cit.*)). Consequently, various places were chosen because of their different climatic conditions—*e.g.*, exposed or sheltered, or whether they were representative of good growing-areas—the idea being that the aphis population would vary with locality, and by periodical examination it was hoped to discover, under field conditions, what part the aphides played in transmitting degeneration diseases. The result has been that *M. persicae* was found to be the transmitting-agent (Whitehead, Currie, and Davies (*loc. cit.*), W. Maldwyn Davies, 1934). In the experiment in Wales it has been discovered that the most important period to note the presence of *M. persicae* in the crop is early in the growing-season. For various reasons the population of *M. persicae* later in the season is not necessarily indicative of the amount of spread of virus.

A similar scheme to the Welsh one was inaugurated in New Zealand in the 1929–30 summer season, when a line of Arran Chief potatoes was distributed to farmers at Cheviot, Rangiora, Annat, Highbank, Fairlie, and Willowbridge in Canterbury, at Alma in North Otago, at Balfour in South Otago, and at Winton Experimental Farm in Southland. A sample of this same "seed" was also grown at Ashburton Experimental Farm. This line of potatoes was to be grown at each area for several seasons, and after each season's crop a sample of the "seed" was to be sent to Ashburton, the control, where all the samples were then grown side by side, the purpose being to study the amount of virus disease each sample had developed at each growing-area. The results of this experiment have been recently reported on by the Fields Division of the Department of Agriculture in this *Journal* (1935).

It was the duty of the writer to inspect the plots at the various areas in the season 1929–30, and the results of this investigation have been reported in the *New Zealand Journal of Science and Technology* (Cottier, 1931). In view of the results of the work in Wales, it has been thought interesting to consider New Zealand results. In the Fields Division report (*loc. cit.*) "seed" grown at Willowbridge, Rangiora, Alma, and Cheviot showed a progressive increase in virus infection as the experiment was continued. That grown at Highbank, Fairlie, Balfour, Annat, and Winton showed no increase in the amount of virus. Although the insect inspection was carried out in one season only—viz., the first season of the experiment, 1929–30—it is extremely interesting to note that the results show that in December *M. persicae* was most abundant at Alma, Willowbridge, and Rangiora, while at Annat, Highbank, Fairlie, and Winton the numbers of this aphid were very small. Later, however, in January, *M. persicae* was present at these places as follows, the order given being that of decreasing abundance: Balfour, Winton, Highbank, Alma, Fairlie, Annat, Rangiora, and Willowbridge. In March the infestations, in decreasing order of magnitude, were: Fairlie, Alma, Highbank, Willowbridge, Winton, Balfour, and Rangiora. In short, if the position be investigated, it will be noted that the results, as far as they go, interpreted in the light of the Welsh findings, are in agreement with the conclusions reached in Wales, viz.:—

(1) That of the three characteristic aphides, *Myzus persicae* is the most important vector of potato virus disease.

(2) That infestation by *M. persicae* early in the season is the most important factor in the spread of virus disease.

To the writer these conclusions offer the most satisfactory explanation to date of the problem as it appears in this Dominion.

When the New Zealand investigation into the potato-insect fauna was begun it was thought that some places would be discovered where the aphis population was characteristically very small or almost nil over the whole season. This, however, did not prove to be the case. Rather it was found that infestation was general and it would appear that the important thing is not the total amount of infestation in a season, but the amount of infestation by *M. persicae* early in the season. The Fields Division report (*loc. cit.*) states that "the districts producing seed giving rise to crops relatively low in virus infection and relatively high in yield were those which by reason of latitude or altitude were possessed of cooler climates than the districts supplying the remaining lines under trial." During a normal season, in the cooler climates and in exposed situations, the aphides would not secure so early a start as would those in warmer and more sheltered places, although they might breed up to equal numbers later in the season. Thus in the colder and more exposed areas there is a longer period during which the young plants are free from aphis infestation, and this is apparently the reason for their relative freedom from virus diseases.

In connection with the conclusion that freedom from infestation by *M. persicae* early in the season is the most important means of securing success in producing virus free potatoes, it is well to remember that it has been demonstrated in New Zealand (Cottier, *loc. cit.*) as well as in Wales (Davies, *loc. cit.*), that cruciferous crops (swedes, rape, cabbage, &c.) act as over-wintering havens and reservoirs of potential infestation by *M. persicae* to nearby potato fields. So that the greater the isolation of the potato area the smaller will be the chance of infestation by these aphides.

Up to the present time it has not generally been considered an economic proposition to spray large areas of potatoes for the purpose of ridding the fields of virus-carrying aphides, unless such areas are showing wilting due to severe mechanical damage by the insects. In cases where it is deemed advisable to spray, black-leaf 40, 1 part to 800 parts of water, plus soap 2 lb. to 3 lb. per 100 gallons of spray, should be used.

ACKNOWLEDGMENT.

Thanks are due to Dr. H. H. Allan, of this Station, for kindly identifying aphis-hosts.

REFERENCES TO LITERATURE.

COTTIER, W. (1931): An Insect Survey of Potato Foliage in New Zealand, *N.Z. Jour. of Sci. and Tech.*, Vol. 13, No. 3, pp. 125–139.

DAVIES, W. MALDWYN (1934): Studies on Aphides infesting the Potato Crop, *Ann. App. Biol.*, Vol. 21, No. 2, pp. 283–299.

FIELDS DIVISION OF DEPARTMENT OF AGRICULTURE, N.Z., (1935): Locality in relation to Seed-potato Production. *N.Z. Jour. of Agric.*, Vol. 50, No. 2 pp. 98–106.

PATCH, Miss E. M. (1928): The Foxglove Aphid, Bull. 346, Maine Agric. Exp. Sta.

—— (1915): Bull. 242, Maine Agric. Exp. Sta.

WHITEHEAD, T., CURRIE, J. F., and DAVIES, W. MALDWYN (1932): Virus Diseases in relation to Commercial Seed-potato Production. *Ann. App. Biol.*, Vol. 19, No. 4, pp. 529–549.

THE SIZE AND DISTRIBUTION OF DAIRY HERDS IN NEW ZEALAND.

E. J. FAWCETT, Economist, Department of Agriculture, Wellington.

THE total dairy herd of New Zealand has increased by approximately 500,000 cows since 1929–30. This rapid expansion has taken place coincident with a decline in commodity prices, and there have been many conjectures as to the types of farms on which the major development has taken place. An analysis of holdings, based on herd size, was made by the Government Statistician for the 1929–30 season, and again for the 1933–34 season. Consideration and comparison of the data contained in these tabulations gives us an indication of the direction in which dairying has developed during this period.

The Government Statistician's figures are based on agricultural and pastoral enumerations as at 31st January. For purposes of classification, farms are broken into two groups, namely :—

(1) Holdings wholly or almost wholly devoted to dairying.*

(2) All holdings.

The figures used refer to holdings of one acre or over situated outside boroughs. For this reason the total number of dairy herds shown does not check with the total number of suppliers to dairy factories. For the 1929–30 season the total number of herds enumerated was 65,496†, whilst there were 59,417 suppliers to factories. In 1933–34 there were 70,434 herds enumerated, but 71,837 suppliers were recorded in the factory lists for that season‡. In 1930 there were 19,671 holdings in respect of which returns were submitted showing no dairy cows, whilst in 1934 there were 13,934 holdings in this category.

It can be assumed safely in many instances that these holdings carried cows for the provision of household milk, but were not concerned with factory supply.

The first movements of importance which should be noted, therefore, are that the number of herds enumerated increased and that factory supply had become general by 1934, when factory-suppliers exceeded the total number of herds recorded outside boroughs. It is clear that financial stringency amongst sheep-farmers in the early stages of the depression caused many of them to develop dairy herds of various sizes, and all of them to supply factories with their surplus produce if cream collection was practicable. During the period 1930–34, total production increased by 36 per cent., whereas suppliers to factories increased by 29 per cent.

* Hereafter referred to as "specialized" and "non-specialized" dairy herds or holdings.

† Total holdings outside boroughs : 1929–30, 85,167 ; 1933–34, 84,368.

‡ Hereafter the 1929–30 season will be referred to as 1930, and the 1933–34 season as 1934.

Table 1.—Total Herds of Dairy Cows and their Distribution, in Group Sizes.

Number of Cows.	1930.			1934.		
	Number of Herds.	Percentage of Total.	Percentage Total Cows represented.	Number of Herds.	Percentage of Total.	Percentage Total Cows represented.
1– 9 ..	32,015	48·9	9·0	28,292	40·2	6·1
10– 19 ..	9,027	13·8	9·2	10,769	15·3	7·7
20– 39 ..	12,437	19·0	25·6	13,652	19·4	20·5
40– 59 ..	6,710	10·2	23·0	8,632	12·2	21·7
60– 99 ..	4,195	6·4	22·1	6,679	9·5	25·9
100–149 ..	864	1·3	7·2	1,784	2·5	10·9
150 and over ..	248	0·4	3·9	626	0·9	7·2
Total ..	65,496	100·0	100·0	70,434	100·0	100·0

It will be seen from a study of Table 1 that, coincident with the increase in suppliers, a definite movement has taken place in herd-composition within the supplying-groups. Herds of from one to nine cows have dropped in numbers and in relative importance. All the other groups have increased in actual numbers, but those up to fifty-nine cows have decreased in the percentage they represent within the Dominion herd, whilst the larger herds of sixty cows or more assume greater relative importance. Has this movement taken place mainly in specialized or non-specialized herds?

Specialized and Non-specialized Herds.

The basic figures covering both types of herds for 1930 and for 1934 respectively are given in Tables 2 and 3.

Table 2.—Specialized and Non-specialized Herds, 1929–30.

Number of Cows.	Specialized.			Non-specialized.		
	Holdings (Herds).	Area.	Cows.	Holdings (Herds).	Area.	Cows.
1– 9 ..	9,964	178,763	38,227	22,051	22,814,770	89,734
10– 19 ..	4,656	323,594	67,864	4,371	4,150,805	62,289
20– 39 ..	9,045	1,001,477	263,975	3,392	1,829,598	98,028
40– 59 ..	5,316	855,067	256,402	1,394	711,887	68,494
60– 99 ..	3,449	778,532	255,035	746	554,218	57,405
100–149 ..	688	233,694	79,999	176	236,879	21,337
150 and over ..	183	113,519	40,148	65	187,489	14,917
Total ..	33,301	3,484,646	1,001,650	32,195	30,485,646	412,204

Table 3.—Specialized and Non-specialized Herds, 1933–34.

Number of Cows.	Specialized.			Non-specialized.		
	Holdings (Herds).	Area.	Cows.	Holdings (Herds).	Area.	Cows.
1– 9 ..	11,653	199,590	44,897	16,639	18,596,298	72,103
10– 19 ..	5,788	430,230	81,898	4,981	6,223,781	66,208
20– 39 ..	10,340	1,239,090	298,975	3,312	2,676,569	91,093
40– 59 ..	7,155	1,147,390	343,895	1,477	1,136,249	70,489
60– 99 ..	5,655	1,224,703	417,368	1,024	916,316	75,586
100–149 ..	1,516	498,735	175,975	268	278,748	31,296
150 and over ..	472	284,734	103,001	154	307,067	35,292
Total ..	42,579	5,024,472	1,466,009	27,855	30,135,028	442,067

It will be noted that in 1930 specialized herds represented 50·8 per cent. of the total, and had increased to 60·5 per cent. by 1934. It is clear that management on many farms has been directed to change from a sheep-dominant to a cow-dominant position during this period. The movement in the various factors are as follows :—

Specialized Group.	Percentage Position 1934 relative to 1930.
Number of herds	Increased by 27·9 per cent.
Total area of farms concerned ..	Increased by 44·2 per cent.
Total cows concerned	Increased by 46·4 per cent.

Non-specialized Group.	Percentage Position 1934 relative to 1930.
Number of herds	Decreased by 13·5 per cent.
Total area of farms concerned ..	Decreased by 1·2 per cent.
Total cows concerned	Increased by 7·2 per cent.

Within the specialized category, increases in cows and in area have been fairly balanced. The increase in area, however, is mainly accounted for by those farms which have changed over to cow-dominant propositions. It will be seen at a later stage that cow increases are mainly influenced by increments in established herds. In the non-specialized group, the number of herds are affected by the switch to "specialized," and the increase in cows is wholly accounted for by enlargement of the dairying side of enterprises already devoted to mixed sheep and dairy farming.

Changes in grouping of Herds on Basis of Size.

The trend towards enlargement of existing herds, and the increasing relative importance of larger herds in the industry, is demonstrated in a comparison of the percentage of the total, which is represented by herds falling within definite size groups. In Table 4 the position in 1930 is compared with that in 1934. In the specialized groups, although the total number of cows in herds of under forty has increased, the percentage of the whole which they represented in 1934 has declined, whereas herds of above forty cows have rapidly increased in relative importance. In the non-specialized groups, small herds of under ten cows have declined in number, whilst others have increased in number and in relative importance. This is specially true of the larger herds on non-specialized holdings.

Wherever practicable, the dairy herds on sheep and mixed farms have been increased in size, and particularly so on farms of about 1,000 acres where comparatively small herds have been developed to augment incomes and to provide some cash income each month.

Table 4.—Percentage Position on Herd Sizes.

Number of Cows.	Specialized.		Non-specialized.	
	1930.	1934.	1930.	1934.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1– 9	29·9	27·4	68·5	59·8
10– 19	14·0	13·5	13·6	17·9
20– 39	27·2	24 3	10·5	11·9
40– 59	16·0	16·8	4·3	5·3
60– 99	10·4	13·3	2·3	3·7
100–149	2·1	3·6	0·5	0·9
150 and over ..	0·4	1·1	0·2	0·5

Size of Holdings.

The validity of the break-up of herds into specialized and non-specialized dairying undertakings can be gauged from the average size of the holdings concerned and the average area per cow as shown in Table 5. The specialized group in 1930 obviously includes small areas which are devoted partially to other activities and small farms which are not fully developed. Those farms carrying larger herds were apparently well developed on the average. The transference from non-specialized to specialized has apparently been mainly farms of small area which have built up herds from ten to thirty-nine cows. Such farms were larger on the average than those milking similar-sized herds in 1930, and result in a less intensive stocking in farms now carrying such herds. On the whole, however, they are typical dairy-farms in area and in utilization. The average area of the non-specialized group, and the resultant area per cow, suggest that the increase in enumerated herds has been mainly on large holdings, while the herds on large holdings which previously returned dairy herds have been increased also, thus moving them into higher grouping.

Table 5.—Group Positions according to Area of Holdings and Area per Cow (in Acres).

Number of Cows.	Specialized.				Non-specialized.			
	1930.		1934.		1930.		1934.	
	Area of Holding.	Area per Cow.	Area of Holding.	Area per Cow.	Area of Holding.	Area per Cow.	Area of Holding.	Area per Cow.
1– 9 ..	18	4·7	17	4·4	1,035	220·2	1,118	261·4
10– 19 ..	70	4·8	74	5·2	927	64·8	1,250	94·0
20– 39 ..	111	3·8	119	4·2	539	18·6	808	29·4
40– 59 ..	161	3·3	160	3·3	511	10·4	769	16·1
60– 99 ..	226	3·1	217	2·9	743	9·7	894	12·1
100–149 ..	340	2·9	329	2·8	1,346	11·1	1,400	12·0
150 and over	620	2·8	603	2·8	2,884	12·6	1,929	8·4

Summary, Period 1930–34.

(1) It has become a recognized practice for farmers to supply factories with their surplus butterfat wherever collection is practicable, but over 40 per cent. of suppliers have herds of under ten cows.

(2) The number of farmers who submit returns showing dairy herds on their property has increased materially.

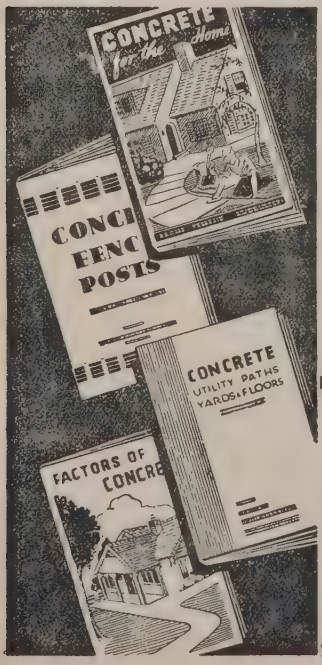
(3) Dairying has assumed a dominant position in an increasing number of farm enterprises.

(4) The major increases in dairy cows have taken place on specialized dairying holdings.

(5) On specialized holdings the major increases have taken place on farms carrying forty cows or more.

(6) Although a number of non-specialized holdings carries large dairy herds, the relative importance of these herds in the dairying industry is small.

In Central Otago a farmer has successfully harvested two crops of seed—rye-grass and white clover—from one paddock at different intervals in the one season. The rye-grass ripened first, and this was harvested directly with the header-harvester, leaving the bottom 6 in. to 8 in. of the sward containing clover untouched. A few weeks later, when the clover was ripe, the crop was windrowed. When this was dry the windrows were picked up by the header-harvester and threshed.



Free

A Free Copy of either of the following remarkably interesting books on the various uses of Concrete, sent post free to anyone who fills in and posts the Coupon below:—

1. *Concrete for the Home.*
2. *Concrete Fence Posts.*
3. *Concrete Utility Paths, Yards and Floors.*
4. *Factors of Good Concrete.*

MAIL COUPON NOW

WILSONS (N.Z.) PORTLAND CEMENT Ltd.
P.O. Box 1359, AUCKLAND.

Please send me, post free, copy of your booklet entitled .....

.....

Name .....

Address .....

.....

CONTROL OF CLUB-ROOT IN CABBAGE SEED-BEDS.

J. G. GIBB, Mycological Laboratory, Plant Research Station, Palmerston North.

CLUB-ROOT is a disease which attacks cabbage, cauliflower, brussels sprouts, and allied crops. It produces a tumid distortion of the roots, and often causes wilting and premature death of the plants. Infection is caused by spores in the soil. To obtain healthy seedlings, which are essential to the production of healthy crops, the spores may be eradicated from infected seed-beds by soil disinfection. Commercial growers possessing high-pressure boilers will find steam disinfection the most economical method; but where steam is not available a chemical disinfectant must be used. At the Plant Research Station, Palmerston North, three seasons' experiments on heavily infected ground* have shown that a 0·1 per cent. acidulated solution of mercuric chloride is the only economically efficient disinfectant for the eradication of club-root from the soil. The treatment costs approximately 4d. per square yard†, and must be applied before sowing. It has no detrimental effect on subsequent germination or growth. *Mercuric chloride solutions are strong poisons and rapidly corrode metals. They should be kept out of reach of children and stock, and containers should be washed after use.* As corrosion weakens the disinfectant, the tins and watering-cans used during application should be protected by rinsing every two hours with benzine containing a little oil.

METHOD OF APPLICATION.

A concentrated solution of the disinfectant which may be kept bottled indefinitely is made up as follows: Mercuric chloride (powder), 1 lb.; commercial concentrated hydrochloric acid, 3 lb. The seed-bed should be prepared for sowing and divided into areas of 2 square yards. Water in 4-gallon tins is carried to the bed, and there $1\frac{3}{5}$ fluid ounces of the concentrated solution rapidly stirred in. The disinfectant solution so formed should be distributed immediately through a fine rose evenly over the 2 square yards previously marked out. Penetration of the disinfectant is deeper when the surface soil is moist and when a gallon of clean water per square yard is applied about an hour after treatment. The seed-bed should be left for ten days before sowing.

The efficiency of the method depends on (i) the rapidity with which the mercuric chloride solution can be poured on the soil, and (ii) the prevention of reinfection by disease-carrying soil. Implements and boots should be disinfected in a solution of mercuric chloride immediately before working on treated beds: for doing this a wooden bucket containing $\frac{2}{5}$ fluid ounce of the concentrated solution per gallon of water, placed near the seed-beds, is helpful. For satisfactory disinfection it is advisable to wash adhering earth from the implements, &c., and to keep them damp with the disinfectant for ten minutes. Metal implements should not be left immersed in the mercuric chloride solution for more than a few seconds.

* Full details of these experiments were published in the *Journal of Sci. and Tech.*, Vol. 14, pp. 145–51, 1932, and Vol. 16, pp. 159–62, 1934.

† This price is calculated with the retail price of mercuric chloride at 15s. per pound, but by co-operative buying the price of treatment should be reduced to less than $2\frac{3}{4}$d. per square yard.

SEED-WHEAT CERTIFICATION.

CERTIFIED CROPS.

UNDER the Government scheme for the certification of seed-wheat, the following additional growers have seed for sale from crops which have passed both field and grain inspections. (Previous lists, to which purchasers are referred, were published in this *Journal* in February, March, and April, 1935) :—

Variety.	Grower.	Acreage.
Hunter's II ..	Brown, F. G., Grassy Hills, Waimate	25
	Cooper, H. J., Opaki, Masterton	9
	Porter, B. G., Tokarahi, Oamaru	30
Solid Straw Tuscan	Marshall, J. H., Tycho, R.M.D., Timaru ..	8
	McLachlan Bros., Rangitumau, Masterton ..	5
	Limbrick, R. E., Mount Hutt, R.M.D., Rakaia ..	13

—*Fields Division.*

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 4th April to 2nd May, 1935, include the following of agricultural interest :—

No. 73352 : Cutting-edge of plough-share ; G. M. Reynolds. No. 73535 : Spraying-apparatus ; M. D. Wibmer, J. C. de la Mare, and A. R. S. Chaplin. No. 73587 : Egg-cleaning device ; A. R. Betteridge. No. 72234 : Harrow ; A. S. Bevin. No. 72503 : Cooling cream ; M. Morison and A. Oates. No. 72596 : Harrow (cognate with No. 72234 above). No. 72999 : Tine for sweep ; W. R. Clough. No. 73543 : Wood-preservation ; G. Gunn. No. 73634 : Milk and cream cooler ; The Berry Engineering Works, Ltd. No. 73648 : Dewoolling sheep-skins ; I. Wilson, T. S. Bull, and C. J. T. Jolly.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s., prepaid.

The Fields Instructor, Greymouth, reports that a Rotomana farmer weighted silage in rather a novel manner. He put in a stack of about 40 tons of silage, then immediately stacked from 10 to 15 tons of hay on top. Both hay and silage are of very satisfactory quality, and there is no mould in hay nor between hay and silage.

It is commonly agreed among sheep-farmers that hoggets do not readily commence eating silage, and in consequence the method successfully adopted by a farmer at Taihape is of some interest. The silage being utilized is made from lucerne, but, unlike the usual material from this source, is almost dry, and approximates the nature of heavily sweated hay. There is an entire absence of any fluid exuding from the pit, and the silage, although quite green in colour, has a very pleasant aroma. Absolutely no difficulty has ever been experienced in regard to hoggets acquiring a taste for this material right from the start. The method of making this class of silage consists of mowing the lucerne and leaving it in the swath until it would be considered ready for cocking as for hay. At that stage it is filled quickly into the pit and covered. There is no doubt that the resultant product is a very fine fodder for sheep. The method employed is indicated by the fact that the whole paddock on a recent occasion was cut, and when ready for raking one-half went into the ensilage pit, the remainder being raked and cocked for curing as hay. The latter was a splendid green sample in the stack.—*Report, Fields Superintendent, Palmerston North.*

CERTIFICATION OF SEED POTATOES.

PROVISIONAL CERTIFICATES ISSUED FOR SEASON 1934–35.

PROVISIONAL certificates are issued with the object of affording growers some indication of the general standard of their crops and assisting them in the disposal of their seed. Certification-tags to be attached to the sacks are issued later, provided that an officer of the Department of Agriculture inspects the graded seed potatoes and is satisfied that they are still of the same standard of purity and freedom from disease as was indicated by the field inspection.

Each crop has received a group number, which indicates as accurately as possible the merits of its produce for seed purposes in relation to the merits of the produce of the other provisionally certified crops of the same variety. Group 1 is the highest and Group 10 the lowest. The difference between any two consecutive groups is small, and in making comparisons the cost of seed and transport should receive consideration.

Crops are also divided into two classes—namely, (1) Certified "Mother" seed; (2) certified "Commercial" seed. Areas sown with certified mother seed are eligible for entry into certification. Areas sown with certified commercial seed are not eligible for entry into certification, except in cases where the seed planted has been raised by the entrant (grower) himself. Growers who intend to purchase seed with the object of entering certification must therefore purchase certified mother seed.

LIST OF GROWERS.

Name and Address.	Group No.	Percentage of Foreign Varieties.	Area in Acres.
AUCKLANDER SHORT TOP.			
Mother Seed—			
Adams Bros., Sheffield (Line A)	2	..	7
Adams Bros., Sheffield (Line B)	2	..	1
Alexandre, H., Belfast	3	..	4
Amor, A. W., Woodend (Line A)	3	..	3
Amor, A. W., Woodend (Line B)	2	0·6	3
Amor, A. W., Woodend (Line C)	1	0·2	2
Amyes, H. C., "Riversleigh," Annat	2	..	2
Anderson's Estate, Lincoln (Line A)	2	..	1½
Anderson's Estate, Lincoln (Line B)	3	0·2	1½
Anderson's Estate, Lincoln (Line C)	3	..	3
Armstrong, P. L., Fernside, R.M.D., Rangiora	2	..	5
Bailey, J., R.M.D., Kaiapoi	3	..	3
Ballantyne, R. F., 58 Hanson Road, Upper Riccarton, Christchurch	2	..	1
Barnett, R., Dunsandel	2	..	3
Barr, H. C., Prebbleton-Springston, R.M.D.	2	..	4
Basher, W. F., care of F. E. Larcombe, Springston, R.M.D.	2	..	3
Bennett, R. R., Eyreton-Kaiapoi, R.M.D.	3	..	2
Breitmeyer and McFarlane, Little River (Line A)	3	0·2	2
Breitmeyer and McFarlane, Little River (Line B)	3	0·5	2
Brown, G. E., Kaiapoi, R.M.D. (Line A)	2	..	2
Brown, G. E., Kaiapoi, R.M.D. (Line B)	2	..	2
Burgess, R. W., care of F. Merrin, Eyreton-Kaiapoi, R.M.D.	3	..	2
Caldwell, G., Courtenay, R.M.D.	2	..	3
Carroll, Mrs. A., Southbridge	1	..	8
Carroll, F. A., Southbridge	3	..	2
Carroll, J., Southbridge	1	..	4
Carroll, T. F., Southbridge	3	..	4
Chambers, A. J., "Carberry," Weedon's	2	..	1
Cherry Bros., Kaiapoi, R.M.D.	2	..	2
Cross, A. E., "Pine Farm," Bennett's, via Rangiora (Line A)	2	..	1
Cross, A. E., "Pine Farm," Bennett's, via Rangiora (Line B)	3	..	1½
Cross, H. E., Sandy Knolls	1	..	2

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Percentage of Foreign Varieties.	Area in Acres.
AUCKLANDER SHORT TOP—*continued.*			
Mother Seed—continued.			
Crozier, W. J., Mount Hutt, R.M.D., Rakaia (Line A)	1	..	3
Crozier, W. J., Mount Hutt, R.M.D., Rakaia (Line B)	1	..	1
Crump, F., Springston, R.M.D. (Line A)	2	0·3	3
Crump, F., Springston, R.M.D. (Line B)	3	..	1
Dyer, H., Southbrook	3	..	3
Eder, T. W., Rangiora-Horrelville, R.M.D.	3	0·5	2
Eder, W., Sefton, R.M.D. (Line A)	2	0·1	3
Ferguson, J. W., R.M.D., Winchmore	3	0·9	5
Foster, T. C., Ladbrook's, R.M.D. (Line A)	3	0·2	7
Foster, T. C., Ladbrook's, R.M.D. (Line B)	3	..	3
Foster, T. C., Ladbrook's, R.M.D. (Line C)	2	..	3
Franks, L. J., 88 Russley Road, Christchurch	2	1·6	4
Gilbert, D. R., East Oxford	2	..	1
Guy, T. A. and E. B., Yaldhurst	3	..	6
Harris, C., Sawyer's Arms Road, Harewood (Line A)	2	..	1
Harris, C., Sawyer's Arms Road, Harewood (Line B)	2	..	2
Hegan, J., and Son, Southbrook (Line A)	2	..	2
Hegan, J., and Son, Southbrook (Line B)	3	0·5	5
Henderson, G., Courtenay, R.M.D.	2	..	2
Heron, F., Rangiora, R.M.D.	3	1·3	15
Hobday, J. H., 33 St. John Street, Papanui, Christchurch	2	..	2
Jellie, J., Russley Road, Upper Riccarton, Christchurch	3	..	3
Johnston, R. H., Dunsandel	2	..	2
Kavanagh, D., 50 Ryan's Road, Upper Riccarton, Christchurch	2	..	4
Kenyon, F., Mina, North Canterbury (Line A)	2	..	1
Kenyon, F., Mina, North Canterbury (Line B)	2	..	1½
King, G. H., West Belt, Rangiora	3	0·4	5
Marshall, D., Killinchy-Leeston, R.M.D.	1	..	10
Marshall, W. H., Prebbleton	2	..	1
Martin, W. E., Kaiapoi, R.M.D. (Line A)	3	..	8
Martin, W. E., Kaiapoi, R.M.D. (Line B)	3	..	3
Matson, A. L., Box 3, Christchurch (Line A)	3	0·1	4
Matson, A. L., Box 3, Christchurch (Line B)	2	..	3
Morgan, D., R.M.D., Cheviot, North Canterbury	1	..	8
Mortland, Mrs. S., Templeton	2	..	2
Mulcock, W. J., Ryan's Road, Upper Riccarton, Christchurch	3	..	1½
Murphy, J., Springston, R.M.D.	3	..	3
McPhail, W. A., Mitcham, via Rakaia	2	..	2
Nairn, G., Lakeside-Leeston, R.M.D. (Line A)	2	0·2	2
Nicklaus, J. F., 104 Ryan's Road, Upper Fendalton, Christchurch	1	..	4
Oakley, J. T., Eiffelton, R.M.D. (Line A)	3	..	2
Oakley, J. T., Eiffelton, R.M.D. (Line B)	3	..	3
Oakley, W., Halkett, R.M.D. (Line A)	1	..	5
Oakley, W., Halkett, R.M.D. (Line B)	2	..	4
Oliver, W. R., Hororata	2	..	1
Overton, H. M., Lakeside	2	..	2
Pascoe, S., Halkett, R.M.D.	3	..	1
Petrie, H. H., Swannanoa, R.M.D.	2	..	8
Petrie, J., jun., Swannanoa, R.M.D.	2	..	2
Petrie, J., sen., Swannanoa, R.M.D.	2	0·1	4
Poulton, A. D., West Eyreton, R.M.D.	3	0·8	2
Prebble, R. L., Springston, R.M.D.	2	..	3
Prisons Department, Paparua	3	..	6
Prosser, L. W., Leeston, R.M.D.	2	0·8	3
Proudlock, A., East Eyreton-Kaiapoi, R.M.D. (Line A)	3	..	4

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Percentage of Foreign Varieties	Area in Acres.
AUCKLANDER SHORT TOP—*continued.*			
Mother Seed—continued.			
Purvis, G., Oxford Road, Rangiora	3	..	2
Rangiora High School, Rangiora (Line B)	2	0·2	5
Rathgen, A. E., Killinchy-Leeston, R.M.D.	2	..	5
Redmond, C., Kimberley, R.M.D.	1	..	20
Redmond, W. G., Courtenay, R.M.D.	2	1·0	2
Robinson, R. G., Ltd., Box 4, Papanui, Christchurch	3	..	6
Rolston, G., Weedon's-Greendale, R.M.D.	1	..	4
Roper, P. F., Halkett, R.M.D.	1	..	3
Roper, R. S., Halkett, R.M.D.	3	0·8	4
Royds, G. E., 12 Burnside Road, Fendalton, Christchurch (Line A)	3	..	3
Royds, R. S., 12 Burnside Road, Fendalton, Christchurch (Line A)	2	..	6
Schluter Bros., Rangiora	2	..	14
Seaton Bros., Courtenay, R.M.D.	3	1·0	2
Smith, E. A., Springston, R.M.D. (Line A)	3	0·6	15
Smith, E. A., Springston, R.M.D. (Line B)	2	..	4
Steele, J., Kimberley, R.M.D.	3	..	1
Stewart, A., Marsh's Road, Templeton	1	..	3
Stoddart, G., Lincoln	2	..	2
Swanson, W., Selwyn	2	..	3
Thomas, J. W., Gray's Road, Upper Fendalton, Christchurch	2	..	3
Tweedy, S., Dunsandel, R.M.D.	2	0·2	1
Ward, C. R. T., Ladbrook's	2	..	2
Watson, R. G., Springbank-Rangiora, R.M.D. (Line B)	2	0·3	3
Weeber, H., Englefield Road, Belfast (Line A)	3	..	3
Weeber, H., Englefield Road, Belfast (Line B)	2	..	2
Westaway, R. J., Courtenay, R.M.D.	2	0·5	10
Williams, C. M., Box 19, Kaiapoi	3	0·7	3
Wilson Bros., Halkett, R.M.D. (Line A)	2	..	3
Wilson Bros., Halkett, R.M.D. (Line B)	3	..	1
Wilson, M., Halkett, R.M.D.	3	0·6	2
Wilson, W. A., Halkett, R.M.D.	1	..	3
Wolff, R. G., Horrelville, R.M.D.	1	..	3
Wright, L. T., Annat	2	..	10
Wright, Q. A., Annat	2	..	6
Commercial Seed—			
Adams, K. and R., Sheffield	4	..	3
Ballantyne, C. T., Gleniti, Timaru	4	..	1
Ballantyne's Estate, Fairview, Timaru	6	0·2	4
Banks, L. C., Lincoln-Greenpark, R.M.D.	4	..	5
Boyle, A. D., Orari	4	0·2	1
Burrell, T. F., Levels, South Canterbury	4	..	1
Couper, R. P., Washdyke, Timaru	4	..	1
Crawford, A. W., 140 Belfast Road, Belfast	5	..	5
Dale, W. S., Kennerley, Temuka	4	..	1
Dowdle, T. S., Prebbleton	4	..	2
Eder, W., Sefton, R.M.D. (Line B)	4	0·5	7
Gaffeney, Mrs. M. F., Arowhenua, Temuka	4	..	2
Gray, J. L., St. Andrew's (Line A)	5	0·3	2
Gray, J. L., St. Andrew's (Line C)	4	..	3
Gray, R., St. Andrew's (Line A)	4	..	2
Gray, R., St. Andrew's (Line B)	6	0·5	6
Haines, C., 108 Waimak Road, Harewood	4	..	2
Ham, A., Grovetown, Blenheim	6	0·4	1½
Hastie, A. W., Pareora, Timaru	4	..	1
Kelleher, T., Pleasant Point, South Canterbury (Line A)	4	..	1

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Percentage of Foreign Varieties.	Area in Acres.
AUCKLANDER SHORT TOP—*continued.*			
Commercial Seed—continued.			
Kelleher, T., Pleasant Point, South Canterbury (Line B) ..	5	0·2	4
King, W. H., Rosewill, Timaru (Line A)	4	..	1
Mills, F. F., Grovetown, Blenheim	4	0·6	1
Musson, W. R., Rangiora	4	0·3	3
McCullough, S. G., Rangitira Valley, Temuka	4	..	1
Oliver, J. O. J., Factory Road, Temuka (Line A) ..	5	..	1
Oliver, Mrs. Z. M., Temuka	4	..	1
Porter, E., St. Andrew's (Line A)	4	..	2
Proudlock, A., East Eyreton-Kaiapoi, R.M.D. (Line B) ..	4	1·1	4
Reynolds, H., Watson's Road, Harewood	5	..	2
Rich, A. J., Kaiapoi, R.M.D.	6	..	13
Rose, H. J., Scott Street, Blenheim	4	1·0	1
Ross, A., Washdyke, Timaru (Line A)	4	..	1
Ross, A., Washdyke, Timaru (Line B)	4	0·2	1
Rouse, J., St. Andrew's	4	..	2
Royds, G. E., 12 Burnside Road, Fendalton, Christchurch (Line B)	4	..	12
Royds, R. S., 12 Burnside Road, Fendalton, Christchurch (Line B)	4	0·4	2
Saunders, W., Clandeboye, Temuka	5	..	1
Seivwright, R. M., "Meadows," Washdyke	5	0·2	3
Sharlick, J., Marshlands Road, Ouruhia, Christchurch ..	4	..	2
Shillitto, R. S., 135 Armagh Street, Christchurch ..	4	..	2
Simpson, F. F., Morven (Line A)	5	..	2
Smith, R. S., "Beach Farm," St. Andrew's	4	0·3	1
Steven, G. H., Rosewill, Timaru	4	0·5	2
Topham, J. W., Arowhenua, Temuka	6	..	3
Traves, H., Levels, South Canterbury	4	0·2	1
Walsh, G., Levels, South Canterbury	4	..	1
Weeber, H., Englefield Road, Belfast (Line C)	4	..	6
DAKOTA.			
Mother Seed—			
Alexandre, H., Belfast (Line B)	5	..	3
Allen, A., R.M.D., Leeston	3	..	9
Banks, L. C., Lincoln-Greenpark, R.M.D.	3	..	1
Barnes, A. C., Cheviot, R.M.D.	5	..	1
Barnett, R., Dunsandel	3	..	4
Barr, H. C., Prebbleton-Springston, R.M.D.	5	..	7
Benny, G., Southbridge	4	..	1
Boyce, A., Doyleston	5	..	5
Burrowes, J., Chertsey, Mid-Canterbury (Line A) ..	5	..	12
Campion, C. A., Highbank, Methven	3	..	20
Carpenter, A. M. and F., Fernside-Rangiora, R.M.D. (Line A)	5	..	1
Carpenter, A. M. and F., Fernside-Rangiora, R.M.D. (Line B)	4	..	3
Carr, J., Methven	5	..	5
Chambers, A. J., "Carberry," Weedon's, R.M.D. ..	4	..	4
Chambers, L. J., "Carberry," Weedon's, R.M.D. ..	4	..	4
Chambers, R., Rolleston	5	..	20
Chambers, W. J., "Carberry," Weedon's, R.M.D. (Line A)	5	..	5
Cherry Bros., Kaiapoi, R.M.D.	5	..	2
Cross, A. E., Pine Farm, Bennett's, via Rangiora ..	4	..	1
Cross, H. E., Sandy Knolls (Line A)	4	..	4
Cross, H. E., Sandy Knolls (Line B)	3	..	2
Crozier, W. J., Mount Hutt, R.M.D., Rakaia (Line A) ..	2	..	10
Crozier, W. J., Mount Hutt, R.M.D., Rakaia (Line B) ..	3	..	3
Donaldson, A., Mitcham, via Rakaia	5	..	2

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Percentage of Foreign Varieties.	Area in Acres.
DAKOTA—*continued.*			
Mother Seed—continued.			
Gardiner, C., Mitcham, via Rakaia	3	..	5
Gardiner, O. J., Dunsandel	2	..	12
Guy, T. A. and E. B., Yaldhurst	4	..	1
Hegan, J., and Son, Southbrook	5	..	3
Hennessey, W., Mitcham, via Rakaia	3	..	1
Hill, L. F., Eiffelton, R.M.D.	4	..	5
Hooper, R. M., Mitcham, via Rakaia (Line A)	4	..	5
Hooper, R. M., Mitcham, via Rakaia (Line B)	4	..	5
Johnston, H. W., Dunsandel	3	..	16
Johnston, R. H., Dunsandel	3	..	2
Jowers, G. C., Springston, R.M.D. (Line C)	3	..	3
Lambie, R. T., Leeston	4	..	5
Leslie, A., Springston, R.M.D.	3	..	2
Manson, C. F., Kimberley, R.M.D.	3	..	4
Marshall, D., Killinchy-Leeston, R.M.D.	4	..	10
Meyer, J. H., Ladbrook's	5	..	8
Miller, J. E., Killinchy-Leeston, R.M.D.	5	..	3
Moorhead Bros., Southbridge	4	..	8
Morrish, F. E., Springston	5	..	4
McCartin, J., Leeston	5	..	5
McLachlan, T. C., Leeston	5	..	10
McPhail, W. A., Mitcham, via Rakaia (Line A)	3	..	12
McPhail, W. A., Mitcham, via Rakaia (Line B)	5	..	1½
McRobb, A., Mitcham, via Rakaia	3	..	1
Nicklaus, J. F., 104 Ryan's Road, Upper Riccarton, Christchurch	3	..	1
Nixon's Estate, Killinchy-Leeston, R.M.D.	5	..	7
Oakley, J. T., Eiffelton, R.M.D.	5	..	2
Oakley, W., Halkett, R.M.D.	3	..	1
Payne, J. W., Lincoln	3	..	3
Petrie, A. D., Woodend	5	..	2
Petrie, J., jun., Swannanoa, R.M.D.	3	..	1½
Petrie, J., sen., Swannanoa, R.M.D.	4	..	5
Phillips, A., Weedon's, R.M.D.	5	..	9
Phillips, A. G., Weedon's, R.M.D.	4	..	4
Phillips, W., Springston, R.M.D.	4	..	4
Piner, E., Annat, R.M.D.	4	..	2
Robinson, R. P., Waikuku	5	..	3
Robson, F. H., Box 22, Lincoln	5	..	12
Rolston, G., Weedon's-Greendale, R.M.D.	3	..	11
Royds, R. S., 12 Burnside Road, Fendalton, Christchurch (Line A)	5	..	2
Ryan, P. F., Weedon's, R.M.D.	4	..	10
Seaton Bros., Courtenay, R.M.D.	5	..	2
Shellock, W., Te Pirita, R.M.D., Rakaia	3	..	12
Steele, J., Kimberley, R.M.D. (Line A)	3	..	1
Stewart, A., Marsh's Road, Templeton (Line B)	5	..	5
Swanson, W., Selwyn	3	..	2
Tweedy, S., Dunsandel	4	..	10
Walker, C. E., Estate of, West Melton, R.M.D.	3	..	6
Watson, E., Dunsandel	3	..	7
Williams, J. W., Halswell	4	..	5
Winter, E. R. V., Brookside (Line A)	4	..	4
Winter, E. R. V., Brookside (Line B)	3	..	1
Wilson, M., Halkett, R.M.D. (Line A)	4	..	2
Wilson, M., Halkett, R.M.D. (Line B)	4	..	3
Wolff, R. G., Horrelville, R.M.D.	3	..	7
Wright, Q. A., Annat	3	..	6

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Percentage of Foreign Varieties.	Area in Acres.
DAKOTA—*continued.*			
Commercial Seed—			
Adams Bros., Sheffield	6	..	1
Alexandre, H., Belfast (Line A)	6	..	3
Amor, A. W., Woodend	7	..	7
Ballantyne, C. T., Gleniti, Timaru	7	..	5
Berry and Halliburton, 28 Dundas Street, Christchurch (Line A)	7	..	3
Burrowes, J., Chertsey, Mid-Canterbury (Line B)	6	..	9
Chambers, W. J., "Carberry," Weedon's, R.M.D. (Line B)	6	..	4
Dale, W. S., "Kennerley," Temuka	6	..	1
Elder, R. P., John's Road, Belfast	6	..	3
Giles, N., Seadown, Timaru (Line A)	6	..	2
Giles, N., Seadown, Timaru (Line B)	7	..	3
Grant, A., Waimate	6	..	4
Mills, F. F., Grovetown, Blenheim	7	..	1
Minchington, F. W., Fernside, Rangiora	6	..	1
Musson, W. R., Rangiora	6	..	2
McCullough, S. G., Rangitira Valley, Temuka	6	..	1
Norman, F. J., Springlands, Blenheim	6	..	4
Pannell, W. B., Rangiora, R.M.D.	6	..	7
Parker, F. A., Spring Creek, Blenheim	7	..	5
Philp, F., Seadown, Timaru (Line A)	6	..	2
Prisons Department, Paparua	6	..	6
Prosser, J. T., Leeston	6	..	5
Reynolds, H., Watson's Road, Harewood (Line A)	6	..	2
Schaffer, F. L., Weedon's-Springston, R.M.D.	6	..	27
Seymour, J., Hawthornden Road, Christchurch	6	..	11
Smart, L. E., Box 3, Lincoln	6	..	7
Steele, J., Kimberley, R.M.D. (Line B)	6	..	1
Steven, G. H., Rosewill, Timaru	6	..	6
Stewart, A., Marsh's Road, Templeton (Line A)	6	..	5
Stoddart, G., Lincoln	7	..	3
Thomas, D., Springston	6	..	10
Ward, W. J., Ohape, Temuka (Line A)	6	..	2
ARRAN CHIEF.			
Mother Seed—			
Anderson, A., Stirling	3	0·6	4
Barclay, G. M. M., Riverlands Road, Waimate (Line A)	4	..	1
Batchelor, R. S., Waimate	4	..	1
Bennett, J., jun., Papatotara, R.M.D.	3	0·5	2
Boyce, W. J., Waituna, Waimate	4	0·2	1
Campbell, P., Studholme Junction (Line A)	4	..	1
Court, R. T., Swannanoa, R.M.D.	4	..	9
Cox, S., Willowbridge	4	..	3
Croft, R., "Glenlea," Amberley	3	..	2
Daly, P. G., Te Waewae	3	1·2	1½
Dobbie, R., Menzies' Ferry	2	1·7	1
Fletcher, W. J., "Hopefields," Willowbridge (Line A)	4	..	2
Graham, Mrs. K. G., Mataura	4	1·0	1
Griffin, J. G., Te Waewae	2	0·2	3
Hamilton, G., Papatotara, R.M.D.	4	1·0	1
Harvey, W., Mosgiel	3	0·2	2
Knowler, C. E., Box 97, Tuatapere	3	0·4	3
Knowler, H., Te Waewae	2	..	4
Knowler, H. C., Te Waewae	3	..	3
Reid, J. M., Box 29, Willowbridge	4	..	1
Robinson, R. G., Ltd., Box 4, Papanui, Christchurch (Line A)	3	..	2
Robinson, R. G., Ltd., Box 4, Papanui, Christchurch (Line B)	3	..	2

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Percentage of Foreign Varieties.	Area in Acres.
ARRAN CHIEF—*continued.*			
Mother Seed—continued.			
Rollinson, F. A., and Sons, Studholme Junction (Line A) ..	4	..	4
Rollinson, F. A., and Sons, Studholme Junction (Line B) ..	4	..	3
Ruddenklau, J. G., The Valley, Glenavy	4	..	7
Saunders, E. E., Studholme Junction (Line A)	4	..	2
Saunders, E. E., Studholme Junction (Line B)	4	..	6
Smith, W. J. M., Seadown, Timaru	4	..	3
Teschner, C. A., Knapdale, R.M.D., Gore	4	1·3	3
Topham, J. W., Arowhenua, Temuka (Line A)	4	0·3	1
Topham, J. W., Arowhenua, Temuka (Line B)	4	..	1
Weir, J. G., Stirling	3	0·3	2
Wright, L. T., Annat	3	..	10
Wright, Q. A., Annat	4	..	1
Commercial Seed—			
Barclay, G. M. M., Riverlands Road, Waimate (Line B) ..	6	..	7
Barclay, G. M. M., Riverlands Road, Waimate (Line C) ..	6	0·2	2
Barnes, W., and Son, 199 Highsted Road, Styx	5	..	5
Beckingsale, J. H., Clearview Settlement, Herbert ..	7	1·6	1
Bruce, J. A., Otahuti, R.M.D...	5	1·4	2
Campbell, P., Studholme Junction (Line B)	6	..	5
Crawford, A. W., 140 Belfast Road, Belfast	5	..	3
Henderson Bros., Otapiri, R.M.D., Winton	6	1·5	2
Henshaw, J. F., Studholme Junction (Line A)	5	..	2
Henshaw, J. F., Studholme Junction (Line B)	6	..	2
Leathwick, A., Hunter, R.M.D.	5	..	7
Leech, C., Rangiora	6	..	4
Manson, D., Enfield, Oamaru (Line A)	6	0·3	1
Manson, D., Enfield, Oamaru (Line B)	7	..	2
Morrison, J. L., Morven	7	..	2
McCarthy, E., Prebbleton (Line A)	5	0·2	5
Oliver, J. O. J., Factory Road, Temuka	6	..	3
Rollinson, F. A., and Sons, Studholme Junction (Line C) ..	5	..	12
Smith, C. R., Bushy, R.M.D., Palmerston	5	1·4	1½
Thomas, R. B., Waihoaka, Southland	5	1·4	2
Topham, J. W., Arowhenua, Temuka (Line C)	7	..	3
ARRAN BANNER.			
Mother Seed—			
Amyes, H. G., " Riversleigh," Annat	3	..	1½
Bennett, J., jun., Papatotara, R.M.D.	3	..	2
Bruce, J. A., Otahuti, R.M.D., Invercargill	4	..	1½
Burgess, D., West Plains, Invercargill	4	..	1
Carr, C., Pukemaori, R.M.D.	4	..	1½
Knowler, C. E., Box 97, Tuatapere	4	..	1
Knowler, H., Te Waewae	4	..	1
Kokay, S., Tuatapere	2	..	2
Milburn, M., Wright's Bush, R.M.D., Invercargill ..	4	..	1
Robinson, R. G., Ltd., Box 4, Papanui, Christchurch ..	3	..	2
Sheddan, G. B., Otahuti, R.M.D. (Line A)	3	..	1
Wilson, C. H., Lorneville, Invercargill	4	..	1
Wright, L. T., Annat	2	..	5
Commercial Seed—			
Barnes, W., and Son, 199 Highsted Road, Styx	5	..	5
Bird, A. M., Timaru Road, Waimate	5	0·2	2
Craig, G. H., Mosgiel (Line A)..	6	..	1
Craig, G. H., Mosgiel (Line B)..	6	..	1
Harvey, W., Mosgiel	7	..	2

LIST OF GROWERS—*continued.*

Name and Address.	Group. No.	Percentage of Foreign Varieties.	Area in Acres.
ARRAN BANNER—*continued.*			
Commercial Seed—continued.			
Leathwick, A., Hunter, R.M.D., South Canterbury	7	..	2
McNae, F., Courtenay, R.M.D.	6	0·6	5
Oakley, W., Halkett, R.M.D.	5	..	5
Robinson, D. B., Waikuku	7	0·5	2
Robinson, R. P., Waikuku	7	0·2	3
Roper, P. F., Halkett, R.M.D.	5	..	2
Sheddan, G. B., Otahuti, R.M.D. (Line B)	7	..	1
Simmons, W., Kingsdown, Timaru	5	..	1
Smith, C. R., Bushy, R.M.D., Palmerston	7	..	1½
KING EDWARD.			
Mother Seed—			
Anderson, A., Stirling (Line A)	4	..	1
Anderson, A., Stirling (Line B)	4	..	4
Bennett, T. A., Te Tua, Southland	4	0·5	2
Burgess, D., West Plains, Invercargill	4	..	1½
Griffin, J. G., Te Waewae	3	..	2
Kokay, S., Tuatapere	3	..	10
Knowler, H. C., Te Waewae	4	..	1
Mehrtens, L. C., Box 27, Tuatapere	4	..	1
Milburn, M., Wright's Bush, R.M.D., Invercargill	3	..	1
Miller, R., East Taieri	4	..	1
Commercial Seed—			
Bruce, J. A., Otahuti, R.M.D.	5	..	1
Craig, G. H., Factory Road, Mosgiel	6	..	3
Graham, J. W., Factory Road, Mosgiel (Line A)	5	..	4
Graham, J. W., Factory Road, Mosgiel (Line B)	5	0·2	2
Graham, J. W., Factory Road, Mosgiel (Line C)	6	..	1½
Kenny, J., Mosgiel	5	..	4
Marshall, W., and Sons, Outram (Line A)	5	..	2
Marshall, W., and Sons, Outram (Line B)	6	..	2
Penn, T. A., 154 Innes Road, Christchurch	6	..	1
AUCKLANDER TALL TOP.			
Mother Seed—			
Court, R. T., R.M.D., Swannanoa (Line A)	4	..	7
Cross, H. E., Sandy Knolls	3	..	2
Eder, W., Sefton, R.M.D.	4	..	1
Frost, C. H., Balcairn P.O.	3	..	5
Guy, T. A. and E. B., Yaldhurst	2	..	3
Marshall, W. H., Prebbleton	4	..	1
Minchington, F. W., Fernside, Rangiora	3	..	3
Reynolds, H., Watson's Road, Harewood	3	..	4
Steele, F., Fernside, Rangiora (Line A)	3	..	1½
Steele, F., Fernside, Rangiora (Line B)	3	..	3
Steele, F., Fernside, Rangiora (Line C)	4	..	1
Thomas, S., West Belt, Rangiora	3	..	3
Commercial Seed—			
Court, R. T., Swannanoa, R.M.D. (Line C)	6	..	5
Frost, S. W., Kaiapoi, R.M.D.	6	..	4
Randall, J., Koromiko, Marlborough	6	0·4	1
Rich, A. J., Kaiapoi, R.M.D.	5	..	6
Roper, R. S., Halkett, R.M.D.	6	1·7	3

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Percentage of Foreign Varieties.	Area in Acres.
EARLY ROSE.			
Mother Seed—			
Basher, W. F., care of F. E. Larcombe, Springston, R.M.D. (Line A)	3	..	1
Burns, R. A. C., Te Pirita, R.M.D., Rakaia	3	..	8
Caldwell, G., Courtenay, R.M.D.	2	..	2
McCoy, J., Te Pirita, R.M.D., Rakaia	2	..	4
McCoy, R. J., Te Pirita, R.M.D., Rakaia	2	..	4
Penn, T. A., 154 Innes Road, Christchurch	2	..	1
Shellock, W., Te Pirita, R.M.D., Rakaia	2	..	5
Weaver, J., care of A. Weaver, Te Pirita, R.M.D., Rakaia ..	3	..	3
Commercial Seed—			
Basher, W. F., care of F. E. Larcombe, Springston, R.M.D. (Line B)	5	..	1
EPICURE.			
Mother Seed—			
Burgess, D., West Plains, Invercargill	4	..	1
Marshall, D., Killinchy, Leeston, R.M.D. (Line A) ..	4	..	2
Robinson, R. G., Ltd., Box 4, Papanui, Christchurch ..	5	..	1
Shellock, W., Te Pirita, R.M.D., Rakaia	3	..	5
Shillitto, R. S., 135 Armagh Street, Christchurch ..	4	..	2
Wright, L. T., Annat	4	..	2
Commercial Seed—			
Campbell, D., King Street, Rangiora (Line A)	6	..	1½
Campbell, D., King Street, Rangiora (Line B)	7	..	4
JERSEY BENNES.			
Mother Seed—			
Burgess, D., West Plains, Invercargill	3	..	2
Milburn, M., Wright's Bush, R.M.D., Invercargill ..	4	..	1
Miller, R., East Taieri	3	..	1
Penn, T. A., 154 Innes Road, Christchurch (Line A) ..	4	..	2
Penn, T. A., 154 Innes Road, Christchurch (Line B) ..	3	..	1
Commercial Seed—			
Craig, G. H., Mosgiel	6	..	1
MAJESTIC.			
Mother Seed—			
Caldwell, G., Courtenay, R.M.D.	5	..	1
Cross, H. E., Sandy Knolls	4	..	2
Crozier, W. J., Mount Hutt, R.M.D., Rakaia	5	..	2
Oakley, J. T., Eiffelton, R.M.D.	4	..	2
Oakley, W., Halkett, R.M.D.	5	..	1
Penn, T. A., 154 Innes Road, Christchurch	6	..	3
EARLY REGENT BOLTER.			
Mother Seed—			
McLennan, C., Courtenay, R.M.D.	5	..	4
Oakley, W., Halkett, R.M.D.	4	..	9
Pascoe, S., Halkett, R.M.D.	4	..	9
Commercial Seed—			
Oakley, J. T., Eiffelton, R.M.D.	7	..	4
AMERICAN WONDER.			
Mother Seed—			
Franks, L. J., 88 Russley Road, Christchurch	5	..	1½
Wright, L. T., Annat	5	..	2

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Percentage of Foreign Varieties.	Area in Acres.
GREAT SCOT.			
Mother Seed—			
Wright, L. T., Annat	3	..	4
Wright, Q. A., Annat	4	..	1
IRON DUKE.			
Commercial Seed—			
Guy Bros., Rangiora, Springbank, R.M.D.	8	0·3	40
Penn, T. A., 154 Innes Road, Christchurch	8	..	2
ARRAN CONSUL.			
Mother Seed—			
Piner, E., Annat, R.M.D.	3	1·0	3
BRESEE'S PROLIFIC.			
Mother Seed—			
Marshall, D., Killinchy, Leeston, R.M.D.	6	0·3	10
INVERNESS FAVOURITE.			
Mother Seed—			
Piner, E., Annat, R.M.D.	2	..	7
ROBIN ADAIR.			
Commercial Seed—			
Robinson, R. G., Ltd., Box 4, Papanui, Christchurch ..	9	..	2
SIR J. G. WILSON.			
Mother Seed—			
Robinson, R. G., Ltd., Box 4, Papanui, Christchurch ..	2	..	2

—*Fields Division.*

FIFTH SCIENCE CONGRESS.

THE papers to be considered in the Agriculture Section of the Fifth Science Congress taking place in Dunedin from 27th to 30th May include the following (names of contributors are given in parentheses): Presidential address, Soil Surveys: Their Importance to New Zealand Agriculture (T. Rigg, M.A., M.Sc.); The Phosphate Status of Ashburton Soils (Miss E. B. Kidson, M.Sc.); Some Problems in Wheat Research (F. W. Hilgendorf, M.A., D.Sc.); The Biological Control of Forest Insects (A. F. Clark); Enterotoxæmia and the Clostridium Welchii Group, with special reference to so called "Pulpy Kidney" of Lambs (D. A. Gill, M.R.C.V.S., D.V.S.M.); Health of Domestic Live-stock of New Zealand (C. S. M. Hopkirk, D.V.Sc.); Dietary Protein in Relation to Sterility (I. J. Cunningham, M.Sc., Ph.D., and C. S. M. Hopkirk, D.V.Sc.); Some Dietary and other Factors associated with Epidemiology of Enterotoxæmia (Pulpy Kidney) of Young Lambs (A. Leslie, F.R.C.V.S.); Live Weight of Pregnant Ewes in Health and Disease (A. Leslie, F.R.C.V.S., and J. W. McLean, B.Sc.Agric.); Irrigation on the Canterbury Farm, with special reference to Management (A. H. Flay, B.Sc., M.Agr.Sc.); Preliminary Irrigation Investigations in Mid-Canterbury (R. L. James, B.Sc., A.A.S.E. (Civil)); Soil Survey in Relation to Irrigation (L. I. Grange, M.Sc., F.G.S.); The Manurial Treatment of Apple-trees (T. Rigg, M.A., M.Sc.); Studies on Apple Fruit Development (Dr. H. O. Askew); Farm Management Studies (G. A. Holmes, M.Sc., B.Agric.); Additional Facts relating to the Genetical Analysis of the Classical Example of Mendelian Inheritance: Smooth Seeded X Wrinkled Seeded in Pisum (J. W. Hadfield, H.D.A.); Recent Developments of Pasture Investigations in New Zealand (A. H. Cockayne); Pedigree Seed-production in Herbage Plants (E. Bruce Levy, B.Sc.).

SEASONAL NOTES.

THE FARM.

Feed Utilization.

DURING recent years, because of misconceptions about the relative feeding-values of such materials as hay, silage, and roots, some gross mistakes in the feeding of stock have occurred. A number of these mistakes have arisen because of attributing to silage a much greater feeding-value than actually characterizes it—at times it has been looked upon as a concentrate akin to linseed or to grains of cereal crops and their products, whereas silage, as usually made, approximates a coarse fodder or a roughage. Some guidance in the feeding of silage is provided from the fact that generally 1 lb. of silage equals in feeding-value 2 lb. of roots, and 1 lb. of good, average hay is equal in feeding-value to from 2 lb. to 2½ lb. of silage. Both the above statements are indicative only of approximate values, for they are subject to the important reservation that both hay and silage vary greatly in feeding-value according to variations in a series of factors. It is known fairly well that there is a multitude of differences in the feeding-value of hays. A common cause of these differences is variations in the kinds of plants in the hay and in the proportions of specific kinds present. Another cause of differences, at times substantial, in the feeding-value of hays is the time of cutting. Immature, leafy growth makes the best hay, and, despite this, farmers at times, because of considering the weather or the bulk of the crop, leave the hay uncut so long that they obtain a stemmy crop which, though heavier, is of less feeding-value than a well-made, immature crop, obtainable by earlier cutting. A further cause of differences in the feeding-value of hays, especially grassland hays, is the manurial treatment of the soil, which operates not only directly upon the composition of individual kinds of plants in the hay crop, but also indirectly upon the proportion of the various kinds of plants—*e.g.*, phosphates may increase clovers. On account of its double action the influence of manuring may affect greatly the feeding-value of hay. The weather conditions during saving affects the quality of hay to a much greater extent than many farmers realize—where there is much rain during hay-making the feeding-value may be reduced to about half. All these factors already specified as causes of variation in the quality of hay, except weathering, which does not affect silage so greatly, may equally affect silage. This is because the feeding-value of silage, like that of hay, depends primarily upon the character of the crop from which the silage is made. By no means is ensilage a magical process of turning poor herbage into nutritious material. Actually the best result that reasonably may be expected, as a rule, is that the silage will be only slightly less nutritious than the crop from which it was made. Sometimes it is substantially less nutritious. This brings up the fact that both in hay-making and in ensilage the changes which occur in the stored material may be of moment. As a rule, in hay, heating is not desired—where it takes place to any considerable extent it may be associated with combustion or with the production of moulds. Suitable heating to a slight extent is considered desirable, being known as "sweating," which produces a slight aroma in the hay and causes the stacks to settle down more firmly and thereby lessens any tendency to excessive drying should the hay be left in the stack over a long period. A practical difficulty arises in securing exactly the condition which will result in "sweating" and not bring about the excessive heating which should be avoided.

While the changes in the material being made into hay are of some moment, those in the material of silage are of prime importance, firstly because the production of brownish to almost black silage which is associated with excessive heating involves an appreciable decline in digestibility and nutritive value in comparison with the production of the greenish or yellow silage resulting from lower temperatures, and secondly because the liquid which at times drains from silage contains soluble material of distinct nutritive value—the loss of nutriment in liquid form from silage increases with the succulence of the herbage, and the loss may be made still greater when the internal moisture of the herbage is supplemented by external moisture due to wet weather at time of saving the silage.

To sum up, the feeding-value of both hay and silage varies with the botanical composition of the herbage, the stage of maturity of the herbage, the manurial treatment of the soil, the amount of weathering of the material, and the changes during curing. Hence it is clear that the feeding-value of hay and of silage varies from season to season and from field to field, and indeed there may be substantial variations in the material from different parts of the one field in the same season. Consequently only experience will enable the individual farmer to determine wisely how to use the hay or silage at hand. However, after allowance has been made for the variations just considered, hay and silage as commonly made may be classed as coarse fodders, the essential difference between them arising from the fact that silage is a watery feed while hay is a dry one, and it is of practical importance that coarse fodders serve most usefully for maintenance instead of for production. The feeding-value of ordinary hay and silage for milking-cows has been demonstrated fully and widely, but many seem not to realize that the yield of milk may be depressed by feeding either or both of these materials in excess. Both normally contain a substantial amount of fibre which lowers their digestibility. Fibre gives bulk, and a certain amount of bulk is necessary in the feed of farm stock generally, but the low yield of cows fed for winter milk production has at times been traced to excess of fibre arising from relatively heavy use of hay or silage. The amount of hay or silage that leads to depression of yield cannot be specified—it varies with the quality of the material and especially with the steminess of the original herbage, and occasionally hay or silage of a particularly leafy nature successfully has been made the dominant constituent of the winter ration of producing animals.

The Feeding of Silage.

The nutritive role in which silage is of outstanding value in dairying is as a winter and spring feed for maintenance purposes.

Silage being watery is not suitable for use with other watery feeds such as roots. It is not recommended that stock be required to depend upon silage alone any more than it is recommended that other good feeds such as mangels, hay, or linseed should be fed exclusively for any extended period. Fortunately, under normal New Zealand conditions, it is not necessary to attempt to feed stock upon only silage, which generally should be used to supplement pastures just as hay and roots are used ordinarily in that way. Silage at the daily rate of in the vicinity of 100 lb. has been fed with success to dairy cows, but not often is there occasion to attempt to feed more than 40 lb. daily, for usually smaller amounts than this suffice in conjunction with the feed provided by the pastures or otherwise. Silage has been fed with good results to sheep, when used to supplement pastures, at the rate of about 2 lb. daily.

Possibly the commonest fault in the use of silage consists in underfeeding it. This fault arises primarily from attributing to it a feeding-value greater than it actually possesses and overlooking that its feeding-value approximates that of the green material from which it is made. For instance, trouble has been experienced when cows have been subsisting

almost wholly upon silage fed at the rate of from 8 lb. to 12 lb. daily, and as this amount is far below that required for mere maintenance the cows really were being semi-starved, and if this treatment were continued long enough death would follow necessarily.

The Utilization of Root Crops.

Roots generally, cereals for green feed and chou moellier, before they have declined in quality because of over-maturity all contain relatively low amounts of fibre, and so may be fed advantageously in conjunction with hay. The winter feeding of stock on roots alone is inadvisable in that it gives a ration too watery and too cold, and one likely to set up digestive disturbances. Heavy feeding of roots is particularly unsuitable for old toothless ewes if the roots are intact, and is inadvisable to any type of breeding-ewe or to dairy cattle. Roots may be supplemented suitably with dry fodder such as hay or chaff. The feeding-out of swedes on land which shortly will be sown in turnips, rape, or swedes should be avoided, as it may lead readily to contamination of the land with club-root and dry-rot organisms. In this regard interest attaches to the fact that chou moellier has been grown successfully on soil known to be contaminated heavily with the club-root organism.

On many farms the pulling and storing of mangels calls for attention in June, especially if the land occupied by the mangel is required soon for another crop, such as oats. But no rule for general application can be laid down safely: in milder districts mangels continue for a longer period to increase in weight, and it is doubtful whether it is advisable to pull such crops early in June if they are not to be used until late August or September, unless the land they occupy is especially required for another crop or likely to become so wet later that it will be difficult to cart off the crop. Mangels should be pulled in good time to allow them to ripen or mature before the stock consume them.

Many sheep-farmers are utilizing mangels successfully without storing them. Customarily, broken-mouthed ewes are turned in to eat off the tops, and the roots are then harrowed out in "breaks" some days before the sheep are given access to them. The feeding takes place relatively late in the season when the mangels, before being dislodged, have undergone a certain amount of natural ripening. Freshly pulled mangels are more subject to injury by frost than those that have been pulled for a few days, and, because of this, if at all possible, broken mild weather should be chosen for the work of pulling. When pitting is to be done, the throwing of the mangels into small heaps, covering the heaps with leaves removed from the roots and leaving them for somewhat more than a week before carting, is favoured by some as leading to better keeping of the roots in the pit.

The practice of allowing stock to fall markedly in condition before commencing the consumption of reserves of feed such as silage, hay, and roots cannot be commended. Its objective may be the possession of reserves of feed in the event of a severe late spring, an objective which, of itself, is quite commendable, but looking to the future in this way may lead to undue neglect of the current requirements of stock, especially if subject to the ravages of parasites, and in any case provision for a severe spring is better made much earlier.

Detailed information about the feeding of other materials such as chaff, grain, bran, straw, &c., to the various classes of stock may be obtained from officers of the Fields Division.

General Pasture Work.

Any top-dressing that still remains to be done before the spring should be carried out as soon as possible: a special benefit of pre-winter top-dressing is stimulation of growth before the low temperature of the soil

leads to the pasture becoming dormant until the spring. Just when it becomes too late to obtain this benefit from pre-winter top-dressing varies according to geographical position, but it is certain that delay now widely is inadvisable. Although, if at all possible, top-dressing should be carried out before the most inactive period of pastures, it may be advisable at times to top-dress during this period as an alternative to inconvenience, and, possibly, inefficiency resulting from spring top-dressing being associated with an unduly heavy rush of work. The influence of phosphatic and potassic manures and of lime applied in the dormant season is not lost, but is merely delayed until the warmth necessary for growth returns. But the position in regard to soluble nitrogenous manures seems very different judging from field experience, which indicates that if conditions unfavourable for growth obtain for any considerable time after the application of such manures their influence is much lessened.

When possible, hay, silage, and roots should be fed out on pastures showing evidence of current ravages of the grass-grub: surviving plants benefit from the consequent additional trampling, and some resowing of seeds contained in the hay may occur to assist in thickening opened swards.

In many districts of relatively mild climates pastures, especially ones containing a substantial amount of rye-grass, if closed towards the end of May or in early June will provide valuable fresh feed in late July and August. The amount of such feed may be increased by the use of a nitrogenous manure such as sulphate of ammonia, from which the results are best when used in conjunction with phosphates and often lime also, while comparatively poor results are likely to be obtained from sulphate of ammonia alone. The desirability of such nitrogenous top-dressing depends largely upon a shortage of feed in late winter or spring.

General Cropping.

At this season it is of practical importance that one of the main factors limiting yields of crops is insufficient tillage, particularly before and also after the sowing of the seed. Under many conditions it would be well to begin straight away preparatory cultivation for such crops as mangels, potatoes, and lucerne. In that preparatory cultivation the two deep ploughings that are sometimes recommended are not always advisable—the surface layers of old swards may contain large numbers of weeds and of their seeds. A first deep ploughing will bury many of these which a second deep ploughing will bring back to the surface, where they readily give trouble, whereas if buried deeply enough the seeds at least cause no trouble. Often the necessary seed-bed can be obtained by skim-ploughing and disking well ahead of sowing, thus pulverizing the surface soil which later is turned down deeply by a full ploughing. In order to place the weed-infested surface layer well underground the use of a skimmer attachment is at times of value.

When the soil is not too wet and cold, oats and barley may at times be sown with success in June to provide useful spring feed. Such crops usually respond profitably to a dressing of from 1 cwt. to 2 cwt. an acre of superphosphate, and should not be drilled deeply. Treatment of seed against parasites such as smut is as desirable as for the seed of cereal crops sown earlier.

When being broken up for arable cropping "twitchy" old pastures should be utilized in a different manner from old pastures which are not "twitchy." Information about this is available from officers of the Fields Division, and is contained in these notes in the May, 1934, *Journal.*

Drainage and the provision of pits and trenches for ensilage offer scope for valuable winter work on many farms.

—R. P. Connell, Fields Division, Palmerston North.

THE ORCHARD.

Pruning Operations.

At this period of the year pruning will have commenced or is about to commence in most orchards, and should be completed, if possible, while the trees are still in a dormant state. This work requires the utmost skill if the best results are to be obtained, and should be undertaken only by experienced persons. Beginners wishing to become qualified pruners should be kept under constant supervision.

The principal object of pruning is to develop and maintain a healthy tree capable of producing a heavy annual crop of first-grade fruit throughout long life. For the first four or five years after planting the aim should be to develop a strong framework capable of supporting a heavy crop. For the next few years, while the tree continues to develop, an endeavour should be made to induce fruit-production. Once these results have been accomplished, the object is to maintain good growth, avoid over-production, and effect the suppression of all undesirable growth.

The response to pruning made by trees in different conditions of soil and climate is extremely varied, and even a greater variance is to be expected with different classes of fruit and even with different varieties of the same class. It is therefore quite impossible to describe any detailed system of pruning that can be expected to give satisfactory results under all conditions. In pruning for tree-formation the operator must bear in mind the importance of developing very strong leaders, without which the tree will be unable to support heavy crops. The number of leaders will vary from three to about nine, according to the system of pruning to be followed. These leaders or main limbs should be arranged spirally around the trunk, giving the tree an open centre. At the time of planting three leaders is ample, and these should be shortened back to about 1 ft. from the trunk of the tree. The foregoing remarks refer to apple, pear, quince, plum, apricot, peach, and nectarine.

As the age of the tree increases, so must the pruning treatment be varied according to the class of fruit-tree, variety, tree-vigour, &c. It is impossible here to explain all or even one of these many systems. To be a successful pruner it is essential that the operator should be able to foretell the subsequent growth that will develop as a result of each cut made. This knowledge can best be obtained by careful observations on the various varieties. Novices in pruning will be helped appreciably in their operations by a full realization of the following facts: (1) Peach and nectarine trees bear fruit on one-year-old wood only; (2) Japanese plums bear fruit on one-year-old wood and older; (3) apples, pears, and quinces are borne on two-year-old and older and on the tips of one-year-old wood; (4) European plums produce fruit on two-year-old wood and older; (5) apricots produce fruit on one-year-old wood and on spurs produced on older wood; (6) the more a shoot approaches a vertical position the stronger is the growth; (7) the more a shoot approaches a horizontal position the more its vigour diminishes; (8) the topmost shoots absorb most sap and outgrow those below; (9) retarding the sap-flow operates against vigorous growth, and, as a result, fruit-buds are more likely to develop; (10) severe pruning increases the sap-flow, which in turn induces vigorous wood-growth unfavourable for fruit-bud development; (11) the vigour of a tree or of a shoot is dependent on the leaf surface upon it.

There has been a radical change in recent years in many commercial orchards in this and other countries in the system of pruning many varieties of apple and pear trees, and to a less extent of stone-fruit

trees. This change involves a method commonly referred to as "long pruning." With vigorous-growing trees and with certain varieties "long-pruning" appears to be preferable to many of the older styles of pruning. The system provides for a maximum of five leaders. In the case of pome-fruit, when the trees are firmly established (one or two years after planting), the leaders are allowed to grow unchecked until the tree has attained the desired height and thereafter pruned to an upright lateral growth. The production of fruiting-arms and lateral growth along the entire length of the leaders is encouraged by preventing fruit setting directly on the leaders until the desired result has been secured. Persons desiring further information regarding this or any other system of pruning should seek the advice of their district Orchard Instructor.

Tree-wound Treatment.

When it is necessary to employ a saw for the removal of large branches, the resultant wound is jagged, and, if left untreated, the cambium layer is prevented from forming callus to heal over the wound. Such unhealed wounds permit the entrance of pests (such as woolly aphis) and diseases (such as silver-leaf). Decay is also liable to set in. To treat such wounds it is advisable to trim carefully the edges of the bark with a sharp knife, leaving a finish with a bevelled edge, and to paint over with coal-tar as soon after the wound has been made as is possible.

Cultivation and Manuring.

The winter ploughing should be undertaken as soon as the foliage has fallen and the cover-crop has reached the flowering stage. Where phosphatic or potassic fertilizers are being used, these should be sown just prior to this, the deepest ploughing of the year, and thereby deposited as close to the roots of the tree as is possible. The ground should be ploughed up to the trees, leaving the finishing furrows midway between the rows to act as a temporary surface drain. To reduce the danger of injuring tree-roots while ploughing, it is a good practice to set the plough to a depth of about 3 in. for the striking-out furrow and increase the depth every second or third furrow so that the finishing furrow will be about 6 in. or 7 in. deep.

—P. Everett, Orchard Instructor, Gisborne.

Citrus Notes.

The copious rains following the long dry spell during the summer months have caused much late succulent growth to appear, and this in a number of localities will not have had time to harden before the danger of frost appears. In those localities where frost is common some means of raising the temperature above the danger-point should be adopted.

The time is now approaching when the harvesting of citrus fruits will be undertaken. Lemons should be cut when they have attained the size of from 2¼ in. to 2½ in., regardless of colour, and then stored and cured to make them ready for marketing. Poorman oranges should be allowed to remain on the trees until they are sufficiently matured to make good breakfast fruit. The practice of picking them green and completing the process of ripening by artificial means is not to be recommended. It is in the encouragement of the consumption of this orange as a breakfast fruit that an increase in the sales can be sought. Sweet oranges should be left to reach maturity on the trees, otherwise the fruits will not have attained sufficient flavour to command attention.

—L. Paynter, Orchard Instructor, Auckland.

POULTRY-KEEPING.

The Breeding-hens.

ALTHOUGH it will be several weeks yet before breeding and hatching operations actually commence, it is full time these operations were planned, for it is always advisable to have everything in readiness if success is to be assured. Generally, hatching operations will not commence before July. Pullets of the heavier breeds hatched then may be expected to commence laying in the following autumn on the rising egg-market. This being so, preparations for this important work should be put in hand now. The breeding-birds at this time should receive the most careful treatment, and it should be unnecessary to emphasize that, if vigorous and profitable stock are to be bred, it can only come from parents of sound constitution in perfect health and condition at the time of mating.

Special attention should be directed to the feeding of the prospective breeding-hens, which should be well fed, but not over fed. Every effort should be made to prevent the birds becoming in an overfat condition during the moulting period or just before eggs are required for hatching purposes, as eggs containing strong germs, and giving chickens that are easy to rear, are seldom or never produced from an overfat hen. The birds should be handled frequently and if there is a tendency for them to put on surplus fat the ration should be reduced slightly. They should also be encouraged to exercise as much as possible. If the breeding-birds are to be maintained in their best vigour, and be capable of producing eggs with the desired strength of germ, they should have a free range, or at any rate ample space for exercise affording some semblance to the condition their nature demands. In a general way the coddled bird is not the ideal specimen to breed from for the maintenance of a flock characterized by heavy production.

It is always good practice to choose for the breeding-pen a hen slightly larger than that desired in a laying flock, or larger even than one suitable for entry in an egg-laying competition. A certain percentage of small birds will come willy-nilly without specially breeding for them. Unfortunately, too many poultry-keepers consider that because small birds are often good layers they must necessarily be desirable specimens for the breeding-pen. This is a great mistake, and the less breeders act upon it the better will it be for the individual poultry-keeper's pocket and the industry generally, while, furthermore, less would be heard of persistent requests to unload small-sized eggs on to the London market. It should be remembered that, as a general rule, the diminutive hen produces a small low-grade egg. No hen should be placed in the breeding-pen which does not produce a standard egg—namely, one of 2 oz.

Litter.

A question frequently asked is how to prevent the litter in the fowl-house piling up under the dropping-boards and perches. This accumulation is due to the fact that the birds, when scratching for food in the litter, always work with their heads towards the light, hence, as the litter is daily scratched back, it necessarily follows that it soon becomes piled up at the back of the house. No doubt if light were provided by means of glass frames being placed low down in the back wall of the house the trouble would be minimized. It is a question, however, whether the expense of doing this is warranted, as, after all, it is not a big job frequently to spread the litter with a fork, and from all standpoints this regular spreading of litter will have a beneficial effect.

Determination of Age of Ducks.

Really there are no physical signs to determine with certitude the age of a duck. The condition of the windpipe, however, is a good guide as to whether a bird is old or young. If the windpipe is hard to the touch, it is safe to say the bird has passed the duckling stage. On the other hand, if the windpipe is soft and yields to the touch it indicates that the bird is comparatively young. In applying this test with a live bird care must be taken that the windpipe is not squeezed to the extent of injuring the bird. With a dead duck the condition of the upper part of the bill gives a good indication of age. In a young bird the bill can be pressed back and easily broken, while with an old one it will be found difficult to do this unless great pressure is used. Another way of deciding between an old and a young bird is the manner in which the breast bone can be pierced with, say, a sharp hat pin. With a young bird the bone can be pierced with but little pressure, but in the case of an old one the bone is harder and offers more resistance.

Fowls sleeping in the Nests.

It is common for fowls, particularly when undergoing the moulting process, to acquire the habit of sleeping in the nests and not on the perches. No doubt the chief reason for this is that being incompletely feathered the birds feel the cold, and resort to the nests, which provide a warmer sleeping-place than the perches. It is a habit, however, which should be broken at the earliest possible moment, for the reason that it not only encourages the presence of insect pests, particularly the red-mite, but in addition the eggs cannot be gathered in a clean state. The red-mite—probably the worst enemy of domestic fowls in this country—usually makes its first appearance on the perches, or, of course, any other place where the birds rest at night. It is a simple matter to deal with the mite when its presence is confined to the perches, by having the ends of the latter arranged in such a way that they or the birds' feathers do not touch the walls of the house and by giving the perches frequent treatment with a strong disinfectant or with kerosene. It is not so simple, however, when the mite once gets a good foothold in the nesting quarters, for from these it may soon spread to hiding-places in the walls, and when this happens it is difficult to tell when the pest will be stamped out.

Once birds take to sleeping in the nest the only practical way of breaking the habit is to place an obstruction in front so as to prevent them from entering. A board placed in front of the nests, or a piece of wire netting arranged in such a way as to be easily put up or taken down, will serve the purpose. The obstruction should be placed in position before roosting-time, and removed first thing in the morning to allow the birds to lay in the nests. Obviously some work is entailed in keeping the birds out of the nests by night, but in most cases this will prove a mere trifle compared with the labour of washing soiled eggs and clearing up vermin-infected quarters.

Pullets moulting.

Several poultry-keepers have asked for advice on, and are at a loss to account for, pullets hatched at the right time going into a moult just when it was thought they had settled down to a prolific winter laying-season. Without seeing the birds or making a close examination, in each case, of the methods of management from the shell to maturity it is a difficult matter to account for such disappointment. There are so many factors responsible for pullets going into a moult at this period of the year that it becomes necessary to search among several possible causes. Especially does this apply in these days when there are so many new ideas on feeding poultry by cheap substitutes and

prepared mixtures allegedly without interfering with the egg-supply. The important subject of reducing the cost of production, when the pullet bred to lay in winter is concerned, is one that should be approached with the utmost care, as obviously when the pullets settle down to egg-production a greater supply of food is required than before the laying period commenced. Reducing the food-supply and repeatedly testing new systems of feeding are common causes of postponement of the commencement of the laying period, also of false moults after laying has started, and a consequent poor egg-supply. A very common mistake is to think that all grain is alike, and that cheap defective wheat, low-grade oats and barley, &c., are economical. The food-value of these is almost invariably in ratio to their cost, and it is generally the case that the best grades of grain are the cheapest in the end, for the bird if given all the green stuff and meat, or its substitutes, desired will satisfy itself with a much smaller proportion of grain of good quality than it will with grain of low grade. The waste also is considerably less than with grain of poorer quality: indeed, cheap grain for poultry is false economy in its worst form. Quality rather than quantity should always be the objective in deciding on the ration for the layer. This is not to infer that the cost of feeding fowls should not be reduced to a minimum, providing of course the birds' health and their production are not interfered with in the process. Probably the one way open to the average poultry-keeper to reduce the cost of feeding lies in the direction of supplying good green food in abundance. In any case, this suggested lowering of feeding-costs is much more easily accomplished in the warmer months of the year—*i.e.*, the fowls' natural laying-season. In the case of some poor egg returns, and judging by the inferior samples of pollard that have come under my notice, it is not surprising that the pullets went into a moult and ceased to lay: indeed it would have been surprising had they not.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

Care of Hives.

At no other season is the welfare of the colonies of such importance as during the next few months. Every hive should be raised from the ground to the height of one brick, and if the situation is damp or low-lying it is a good plan to raise the hives still more. This tends to keep them free from slaters (wood-lice) and other insects, and affords less harbour for mice, as well as ensures a free current of air beneath the bottom-boards, which are thus more likely to keep dry. The bottom-boards should never be rested on the ground, or they will rot in a very short time and become mouldy and evil-smelling.

Before bad weather sets in it is a good plan to give a coat of paint wherever it is needed, at the same time stopping up all cracks in the supers. Cracks afford ventilation during the summer months, but they are hardly to be advocated on that account, because the beekeeper will usually find that towards the end of the honey-flow the bees will use much valuable time in gathering propolis to paste up the cracks in view of the approach of winter. The hives should be canted slightly forward, so that any rain which falls on them will drain off the alighting-board.

Apart from disease, there is no worse feature in an apiary than the presence of leaky hive-covers. A roof which allows moisture to trickle through is a constant menace to the colony it appears to shelter. Not only will the mats immediately beneath it become sodden and mouldy, but the cluster of bees in the hive stands in danger of extermination when

frost sets in. There will then be pollution unspeakable on the bottom-board, where the intruding moisture mixing with dead bees and waste pollen forms a rotten fermenting mass, with a stench which the order-loving bees must find more obnoxious than does their owner. There is no excuse for leaky covers. In the autumn the apiarist should examine them for any doubtful spots, and should cover them with either zinc, ruberoid, or some other waterproof material. If economy must be practised he may cover with cheesecloth, applying to the roof first a coat of paint, then the cheesecloth, and then another coat of paint. This makes an effective waterproofing, and one which anybody can apply.

Removing Spare Supers.

As advised last month, all top boxes not actually occupied should be removed and the bees made as snug as possible. If the colonies have been cared for well, and are headed by good queens, they will need at least one top box in addition to the brood-chamber, which will be fairly crowded with young bees bred since the close of the main honey-flow. These are colonies that the beekeeper should strive to have, as they will come out strong in the spring and give the best returns when the next season's honey-flow arrives. In removing supers at this time every care must be exercised to avoid robbing. There will be bees in the supers to be removed, and these can be got rid of by using bee-escapes. By putting these on in the evening the supers will be clear of bees in the morning, providing there is no brood in the combs. All operations at this period should be carried out as expeditiously as possible so as not to attract robber bees, which are much in evidence during the warm hours of the autumn days.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

Pruning Hardwood Plants.

TREES and shrubs that are highly trained often have the new growth thinned and shortened during the summer; but the main pruning-season, especially where older wood has to be removed, is the winter, and towards the end of that season for evergreen and for deciduous plants liable to injury by late spring frosts. To obtain good results, whether one is growing the plants for timber, shelter, shade, fruit, or display, &c., this highly important operation requires careful consideration and execution. Premature decay in a tree frequently is set up by snags, formed when pruning, dying back into the heart of the tree. This can be avoided by cutting the branches off flush at the base when it is necessary to remove them. If they are of any size an under-cut, before the cut from above which completely severs the limb, will prevent the sap-wood and bark making an ugly tear when the limb falls. The wound then should be coated with tar or thick paint to keep out water and decay, which it will do effectually if the coating is renewed as required until the wound has healed. If it is not desirable to cut a branch out completely, it is usually quite satisfactory to make a clean cut through the branch just beyond a lateral growth or a well-developed bud. If attention were paid to these few rules the trees on the majority of farms would be in a much better condition.

When trees or shrubs are planted out it is desirable that they should branch out vigorously a little above the surface of the ground or higher; or possibly it is desired to grow a straight trunk without large limbs—in other words, assume some definite shape. For whatever plan is favoured, the training should commence in the pruning-season when the plants are two or three years old. Each tree should be looked over annually at that season for a few years, and given such pruning as may be required to carry

out the design. It then probably will make a very satisfactory plant and require little attention afterwards. The main features to be watched at this stage and modified by means of pruning are shape, balance, and vigor.

Where plants of moderate to large size are being shifted, especially where the roots have been considerably reduced, the tops should be thinned and shortened so that they may not suffer during the summer from the restricted supply of sap from the root.

Pruning and training Small Fruits.

Established plantations of raspberries, loganberries, and black currants, which produce their fruit on the growth of the previous season, are usually pruned immediately after the harvest, and the old wood is carried out and burnt, thus removing the danger of propagating diseases and pests, and allowing the new growth to ripen. If this has been omitted it may be done now by cutting away at the ground surface the canes of raspberry and loganberry that have borne fruit, and removing the unripe ends of the young canes retained for fruiting next season. The old wood in black currant bushes is cut back to a bud at its base, and if weak new growth, which is unlikely to carry fruit next season, is also treated in the same manner it will tend to encourage that vigor in the plant which is an advantage with this type. Gooseberry plants also may be treated in this manner, although some growers like to shorten the new growth to a few buds only in each case. In the case of red currants we have plants which decidedly carry the fruit on spurs on the old wood. The method here is to suppress suckers, to which red currants are very prone, retaining only perhaps a growth here and there to take the place of leading growth which has become exhausted and has to be removed. Then it is advisable to look over the spurs borne by the permanent frame-work of the plant and thin out, invigorate, or check them as may be necessary. As a rule those at the base of the plant require to be invigorated to some extent by cutting them back to wood buds.

To obtain good results the pruning should be followed up now by applying a good dressing of old farm manure, liquid or solid (the former is the richer in plant foods), and working the ground only to a depth sufficient to suppress weed growth—such working avoids injuring the fibrous roots of the plants.

On good land, and with every attention, heavy crops of these berries cannot be borne indefinitely, so that replanting probably will be necessary after a period of eight to ten years. If a new plantation is set out on fresh land that has been carefully prepared it can be brought into bearing before the old one is grubbed out. The pruning policy in the case of young plants is to encourage vigorous growth on an approved plan. Raspberries and loganberries may be cut back to about 6 in. from the surface of the ground ; no shaping need be considered as all new growth springs from the roots annually. Black currants are cut back to make them stool out vigorously ; but little shaping is necessary, as less air and light than usual are required to make these plants fruitful. Gooseberry and currant bushes (red and white) have quite different habits in that abundant air and light are necessary to develop the buds. Any sucker-growth must be suppressed vigorously, and the bush trained up from the one main stem in a way that will make most of the available space, except that the centre remains open : usually training is commenced by retaining three well-placed branches the first year and cutting them back now to carefully selected buds with a view to producing strong, well-balanced forks.

The Homestead Garden.

The good appearance of the homestead garden depends less upon its ornamental character than it does on the general well-being of the trees and shrubs which compose its main features. To develop this well-being and maintain it afterwards a certain amount of supervision is always necessary.

In this probably nothing will be so important as a little pruning at the right season for the purpose of directing growth and making good any injury that may have been caused by accident.

For a shelter-belt to be effective special care is necessary to keep the base well furnished. This can be done only by keeping down all rank herbage which lessens the supply of light and air necessary to maintain the condition of the foliage on those parts. In varying degree, but to some extent for all plants, and all parts of them that we would keep furnished, light and air are as necessary as earth and water. Once foliage is lost it is most difficult to replace. If the base consists of barberry, boxthorn, or other stock-proof hedge plant, it will be sufficient to give it periodical trimming in addition to suppressing rank growth from the ground: any other plant will require also to be fenced securely from stock which would otherwise seriously injure it by rubbing, if not by eating, the lower branches. In the case of shelter trees it may be advisable to do topping, to remove broken or dead limbs, or to cut out unbalanced growth. If this is done in the manner described in the opening remarks there will be rapid improvement and little danger from disease or decay. If the locality is dry these trimmings should be carried out and chopped up for use, as they may start a fire if left in the plantation; in wetter districts, with the exception of the heavier sticks, the litter often makes a useful mulch. With such attentions a shelter-belt of trees will look well and give good service if a suitable selection of healthy trees has been planted.

In the shrubbery borders winter pruning will largely consist of cutting back the growth of over-vigorous subjects inclined to overgrow weaker plants, often of better quality. If the branches for removal are cut just beyond a lateral of moderate growth it will usually have the desired effect, so long as the lateral is not shortened, and the appearance will be natural with very little disfigurement.

It is also customary to prune some of the choicer flowering shrubs and climbers such as roses, hydrangeas, &c. In dealing with this section it is first necessary to ascertain on what part of the plant the flowers are borne. For instance, most kinds of roses and hydrangeas bear the flowers on the new wood; while many early flowering shrubs such as Forsythia and Diervilla carry the blossom on young wood produced the previous season, others again such as Wistaria and species of *Pyrus* carry them chiefly on the older wood and spurs. With this information pruning can be done intelligently, although one must always be careful to cater for the peculiarities of the different species and even different varieties. The study, however, is well repaid, for in most instances no other operation has equal effect in producing satisfactory results. The cardinal principle of avoiding congested growth in hardwood plants must always be observed. A plant looks its best when well furnished, but if the growth is crowded and insufficient light and air is admitted to certain parts, the flower-buds there will be destroyed and possibly growth and foliage also. This training is best commenced in the manner before described when the young plant is first set out.

No feature perhaps requires this careful training more than a garden hedge. It naturally is a prominent feature, and if an even grade of plants is lined out in well-prepared land of even quality the result will be, if properly trained, a handsome contribution to that well-managed appearance that is a decided asset on a property. Where a rather high cypress hedge is to be grown the natural habit of the plant facilitates the work; as it habitually forms abundant breast wood it can be grown to the required height before being stopped by pruning. Where a second leader appears in a plant it should be removed, and the foliage at the base of the hedge carefully preserved by preventing the competition of long grass, and avoid undercutting which will cause the upper portion of the face to lean outward in the slightest degree. It is, however, with ordinary evergreens

such as Escallonia and Coprosma that most difficulties are met; and this chiefly by hurrying the growth upwards before sufficient lateral growth, which it is found almost impossible to obtain later, has been made. For the first year or two the object should be to provide a strong wide base, after which the necessary height is added quickly and easily. The method is to thin out the leading wood in the young plants to a few vigorous growths and shorten them by hard pruning to induce strong hard laterals. It requires a little courage to do this for a season or two, but the rapid growth later will catch up those hedges grown by less commendable methods. If the base is kept wider than the top, and regular trimming is maintained, it will always look well and give good service.

Hedges and shrubberies carry their roots so near the surface of the ground that deep digging is not advisable once the plants are established. At this time of the year nothing suits them better than a light dressing of old manure, with the addition probably of some phosphates. Where neatness demands that the manure be turned under, it is best done now, and this not more deeply than from 3 in. to 4 in.

—W. C. Hyde, Horticulturist, Wellington.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

TAKING SUCCESSIVE CROPS OF POTATOES.

R. W. F., Ruatoria :—

Owing to scarcity of suitable ground I have grown potatoes for three successive years in what was originally virgin bush country. Last autumn was the first time I top-dressed, used 2 cwt. blood and bone with 2 cwt. phosfull, and dug quite a reasonable crop considering the season. Do you think I could expect another fair crop next year if I top-dressed and ploughed twice? If so, what manure is best for potatoes?

The Fields Division :—

It is considered not good practice to take a crop of potatoes from the same land four times in succession. Potatoes always grow and yield best and are usually more healthy if taken as a maiden crop from new land or after lea. In exceptional instances, such as in the case of growers who cater for very early markets, successive crops are often taken from the same land with very heavy manuring, but in such cases neither heavy yield nor good quality is very important. Experience suggests that you cannot expect a payable fourth crop in succession from the same land. In potato-growing a manurial dressing which widely gives good results is 2 cwt. superphosphate and 2 cwt. blood and bone per acre.

CUTTING OF SEED POTATOES.

R. W. F., Ruatoria :—

Is it advisable to cut big potato-seed? If so, should the cut surfaces be sun dried, or kept moist before planting?

The Fields Division :—

It would certainly be more economical to cut very large potatoes for seed, but there is no necessity nor is it wise to cut seed that conforms to the size of a hen's egg. If you decide to cut your large seed, you should plant the cut seed *immediately it is cut* without any attempt at drying the cut surfaces.

WEATHER RECORDS: APRIL, 1935.

Dominion Meteorological Office.

NOTES FOR APRIL.

APRIL was a very mild month with comparatively little stormy weather. The rainfall was irregularly distributed, some districts having much more and some much less than the average. There were, however, few places in which a shortage of moisture gave trouble. There was exceptionally good growth of grass for the time of year, and the country looks very green. The milk-yield has been well maintained, and stock are in good condition. Some facial eczema amongst sheep is still reported from Poverty Bay. In Canterbury and a few localities on the east coast of the North Island where there was a good deal of cloudy weather the new feed is still soft, but elsewhere, particularly in the North Island, the high temperatures and ample sunshine have enabled it to harden, and in many cases the condition of pastures resembles that of a good spring month.

Rainfall.—Parts of western Taranaki and most of the Wellington Province had less than the average rain, but over practically all the remainder of the North Island there was a considerable excess. Many places in the Bay of Plenty and Hawke's Bay had more than double the average. At Napier more than three times the average was recorded.

In the South Island, much of Nelson and Marlborough and parts of Southland had more than the average rainfall, but elsewhere it was a dry month. Parts of South Westland and the interior had deficits of over 50 per cent.

Temperatures.—For the sixth month in succession mean temperatures were everywhere considerably above normal. The departures were highest in the northern and western parts of the North Island, where they were in the neighbourhood of 3° F. In the South Island, and especially eastern districts, they were not so high. There were few frosts, and no severe ones.

Sunshine.—Sunshine was below normal in Hawke's Bay, Canterbury, and Central Otago, but above it elsewhere. Nelson reports 230·8 hours, Tauranga 207·5, and New Plymouth 194·9.

Storms Systems.—The weather was slightly disturbed during the first few days of the month, and during the 3rd and 4th the passing of a westerly depression was accompanied by heavy rain in western and far southern districts.

After a spell of fine weather with anticyclonic conditions ruling, there was a stormy period from the 10th to the 14th, especially over the North Island. The distribution of pressure was complicated, but towards the end of the period there was a deep and slowly moving cyclone off East Cape. At the beginning there were north-easterly gales in the Auckland Province, while at the end southerly gales blew over the North Island. Heavy rains were practically general. In many parts of the North Island there was flooding, Hawke's Bay suffering most. Some severe thunderstorms occurred, and snow fell on the mountain-tops.

The next stormy period was from the 21st to the 24th. A depression developed off the west coast of the North Island and moved eastward, only very slowly. North-easterly gales again blew in the north. Except in parts of the Wellington Province and eastern districts of the South Island, heavy rain was general. Some exceptionally heavy falls were recorded in the Waikato and Bay of Plenty districts, several places having more than 7 in. in twenty-four hours. High floods occurred in these districts, and Taranaki and North Auckland also suffered to some extent. Severe thunderstorms were reported, especially from Taranaki.

Further widespread rains occurred in connection with depressions passing between the 26th and 28th, but there were not many heavy falls. The mountain-tops again received a coating of snow.

RAINFALLS FOR APRIL, 1935, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average April Rainfall.	Total Rainfall to Date.	Average Rainfall to Date.
			North Island.			
	Inches.		Inches.	ches.	Inches.	Inches.
Kaitaia	6·27	13	2·12	4·42	22·61	14·96
Russell	8·36	8	4·01	4·25	37·21	13·77
Whangarei	3·80	16	1·45	4·93	27·43	17·18
Auckland	5·07	16	1·96	3·54	21·31	12·40
Hamilton	6·34	16	2·93	3·85	13·26	14·09
Rotorua	5·83	12	1·92	4·47	24·41	15·91
Kawhia	7·09	14	2·01	4·65	20·35	14·48
New Plymouth ..	6·51	15	2·47	4·60	26·54	16·30
Riversdale, Inglewood ..	7·85	14	3·16	8·11	40·80	28·69
Whangamomona ..	4·97	7	1·23	6·52	31·45	20·97
Hawera	4·50	13	1·24	3·48	21·05	12·40
Tairau	7·16	7	2·28	5·96	28·90	19·51
Tauranga	9·88	11	4·18	4·77	23·03	16·34
Maraehako Station, Opotiki	12·59	15	3·22	4·74	26·99	16·43
Gisborne	4·76	15	2·37	4·05	14·67	14·65
Taupo	4·22	8	1·25	3·60	18·48	12·85
Napier	9·33	13	2·84	2·78	16·86	11·62
Hastings	7·83	14	3·00	3·33	14·17	10·27
Whakarara Station ..	5·32	13	3·05	..	21·36	..
Taihape	1·84	14	0·48	2·79	11·30	10·79
Masterton	1·91	16	0·39	3·05	7·44	11·19
Patea	2·71	13	0·64	3·67	18·24	13·01
Wanganui	2·72	10	0·94	3·27	15·38	10·99
Foxton	1·69	9	0·54	2·50	9·59	8·69
Wellington	1·79	12	0·50	3·53	10·85	12·12
			South Island.			
Westport	6·37	14	1·43	8·25	30·54	29·30
Greymouth	7·59	13	2·14	8·48	35·62	32·66
Hokitika	8·20	13	2·62	9·33	45·65	36·23
Ross	8·25	11	2·39	12·18	40·56	44·21
Arthur's Pass	6·99	8	2·75	15·42	54·42	52·63
Okuru, South Westland	5·27	6	2·47	14·12	49·39	50·52
Collingwood	7·87	9	2·79	8·15	25·83	25·81
Nelson	3·88	7	1·26	3·11	17·65	11·46
Spring Creek, Blenheim	2·71	6	1·00	2·12	8·51	8·50
Seddon	1·92	6	0·51	1·71	6·09	7·40
Hanmer Springs ..	2·84	9	1·11	3·32	10·56	13·62
Highfield, Waiau ..	3·50	9	1·82	2·60	8·38	11·02
Gore Bay	2·10	8	0·63	2·38	7·45	9·77
Christchurch	1·40	13	0·60	1·86	4·43	7·76
Timaru	1·40	9	0·44	1·59	7·99	7·90
Lambrook Station, Fairlie	1·85	8	0·93	1·97	8·21	8·55
Benmore Station, Clearburn	1·19	6	0·60	2·40	10·42	9·20
Oamaru	1·20	11	0·37	1·79	8·17	7·40
Queenstown	2·00	6	1·12	2·98	13·81	10·45
Clyde	1·39	4	1·03	1·45	7·23	5·85
Dunedin	1·56	10	0·78	2·77	12·73	11·87
Wendon	2·29	10	1·12	2·71	14·08	10·91
Balclutha	2·01	11	0·87	2·19	12·33	8·80
Invercargill	5·47	17	1·70	4·14	19·09	15·14
Puysegur Point ..	6·91	17	1·21	7·67	30·56	29·00
Half-moon Bay ..	6·40	16	1·75	5·10	20·01	19·37